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NUCLEAR SAFETY TECHNICAL REPORT

REFERENCE COMPUTATIONS OF PUBLIC DOSE AND CANCER RISK FROM AIRBORNE RELEASES OF PLUTONIUM

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SUMMARY

This report presents results of computations of doses and the associated health risks of postulated accidental atmospheric releases from the Rocky Flats Plant (RFP) of one gram of weapons-grade plutonium in a form that is respirable. These computations are intended to be reference computations that can be used to evaluate a variety of accident scenarios by scaling the dose and health risk results presented here according to the amount of plutonium postulated to be released, instead of repeating the computations for each scenario. The MACCS2 code has been used as the basis of these computations.

The basis and capabilities of MACCS2 are summarized, the parameters used in the evaluations are discussed, and results are presented for the doses and health risks to the public, both the Maximum Offsite Individual (a maximally exposed individual at or beyond the plant boundaries) and the population within 50 miles of RFP. A number of different weather scenarios are evaluated, including constant weather conditions and observed weather for 1990, 1991, and 1992. In particular, the doses and health risks for unfavorable and typical weather conditions are evaluated. The evaluations used a variety of dry deposition velocities for both "no fire" and "with 6 MW fire" conditions. For "no fire" the MOI dose is about 2 rem for unfavorable weather conditions and 0.1 rem for typical conditions, for this one gram release; for "with fire" the MOI dose is about 0.1 rem for unfavorable weather conditions and 0.03 rem for typical. The total number of latent cancer fatalities within 50 miles of RFP is found to be about 0.1 for unfavorable weather conditions and 0.01 for typical conditions for this one-gram release; the presence or absence of fire makes little difference for the population cancer rate. These doses and health risks are quoted to only one significant figure because of the uncertainties in the model and its parameters and because of year-to-year variations of about a factor of two in doses and health risks, due to differences in meteorological conditions.

The isotopic mix of weapons-grade plutonium will change as it ages, the ^{241}Pu decaying into ^{241}Am . The ^{241}Am reaches a peak concentration after about 72 years. The doses to the bone surface, liver, and whole body will increase slightly but the dose to the lungs will decrease slightly. The overall cancer risk will show almost no change over this period. This change in cancer risk is much smaller than the year-to-year variations in cancer risk due to weather.

Finally, χ/Q values are also presented for other applications, such as for hazardous chemical releases. These include the χ/Q values for the MOI, for a collocated worker at 100 meters downwind of an accident site, and the χ/Q value integrated over the population out to 50 miles.

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1 INTRODUCTION

In the course of evaluating the consequences and risks of postulated accidental releases of radionuclides from the Rocky Flats Plant (RFP), many similar scenarios have been, and will continue to be, evaluated again and again. The purpose of this report is to present some standard, or "reference", computations that can be used as the basis for such evaluations, thus avoiding unnecessarily redundant computations. The computations are specifically for the dose to the Maximum Offsite Individual (MOI - a maximally exposed individual at or beyond the plant boundaries) and the health risks to the population surrounding RFP out to a distance of 50 miles. These reference computations consider releases that are small enough that there is no need to evacuate or relocate the population surrounding RFP. The results presented here can be scaled, within a limited but reasonable range, to cover a great number of the scenarios typically evaluated in Safety Analysis Reports (SARs), Environmental Assessments (EAs), and related documents. Most of the accidents postulated in such documents involve the release into the atmosphere of relatively small amounts of Weapons Grade (WG) Plutonium (Pu) in a chemical form (such as plutonium oxide) that causes it to reside in the lungs for a very long period (lung clearance class Y) once it has been inhaled; it is for these scenarios that this report should prove useful. Clearly, there are other scenarios and other population groups, not covered here, that will have to be evaluated on a case-by-case basis, for example, an accident involving a Pu criticality or the consequences to on-site workers. The results given below are not appropriate for a release in which the Pu is in a nitrate (or other soluble) form, which has a lung clearance class of W and therefore a different set of factors for converting intake to dose. In particular, the nitrate form would give a much larger ingestion dose than the oxide form. (The computations for the nitrate form of Pu have not been performed because the dose conversion factors for lung clearance class W for plutonium are not available in the computer model used.)

1.1 DEFINITIONS OF CONSEQUENCE AND RISK

Because the terms consequence and risk have been defined in different ways in various documents, depending upon the application, their use here must be clarified. In this report, consequence is a general term that can mean either dose or risk and can be applied either to an individual or to a population. Risk, on the other hand, specifically refers to health effects and is defined here as the probability that a given health effect, such as cancer, would occur. It is calculated by multiplying the dose to an organ (or the whole body) by the corresponding stochastic risk factor appropriate for that organ (or the body) and the type of radiation involved. When used for an individual, risk expresses the probability that the individual would contract that health effect; by extension, when the individual risks are summed over a population, the resulting population risk is the number of people in that population expected to contract that health effect. The "probability" aspect arises because the stochastic risk factors, which convert dose to risk, are taken from the studies of many individuals and represent what would be expected to happen to a typical individual or group of individuals.

An extension of the consequence concept can be made by including the probabilities of occurrence of the conditions that would yield a given consequence. In this report, that extension arises only from the variability of the weather. It is then possible to state that a certain percent of the time the weather conditions are such that the consequence would exceed some value, such as, "for the postulated accident, 50% of the time during the year the dose to this individual would have exceeded 1.5 rem." A plot of the probability of exceeding a consequence vs that consequence is known as a consequence curve; when applied specifically to risk, the curve is called a risk curve. For a more complete discussion of risk, see Kaplan and Garrick (1981).

An alternative definition of risk, one often used in SARs, is that risk is the product of the expected consequence (or consequence curve) and the probability of occurrence of the initiating accident. This definition of risk is not used here because the probability of occurrence of accidents is not addressed in this report.

1.2 AVAILABLE METHODS

Many methods have been used at RFP to evaluate the consequences and risks of accidental releases of WG Pu. The simplest are the various spreadsheet computations that were used for the SARs written in the 1980s. These spreadsheets are useful for obtaining approximate answers and doing "sanity checks" on more elaborate methods but their use is discouraged because they ignore many important physical processes and they have not been subjected to the Verification and Validation (V&V) procedures required for formal acceptance of the results. (Verification is the process of showing that the code conforms to specified requirements, such as executing model equations properly; it is normally conducted on the subprogram level during the development of the code. Validation is the process of showing that the overall code conforms with software requirements; it is done after the code has been completed. For atmospheric dispersion and consequence codes, validation would include demonstrating that the code faithfully represents observations within the bounds of the expectations of the code.)

Computer models that are widely used and accepted in the nuclear industry are preferable to spreadsheets for such evaluations. Many such computer models are available. For accidental releases of radionuclides, four well-known, government-sponsored computer models are available. These are the MELCOR Accident Consequence Code System (MACCS) (Chanin, *et al.*, 1990) from the Sandia National Laboratories (SNL), the Hanford Environmental Radiation Dosimetry Software System, second generation (GENII) (Napier, *et al.*, 1988), the Radiological Safety Analysis Computer Program (RSAC) (Wenzel, 1990) from the Idaho National Engineering Laboratory (INEL), and the Terrain Responsive Atmospheric Code (TRAC) (Hodgin, 1985), the RFP-specific code developed for emergency preparedness. Once TRAC has been approved for use at RFP by the Department of Energy (DOE) and the Colorado Department of Health (CDH) for emergency preparedness purposes, a version of it may be developed to support safety analysis consequence and risk assessments. After DOE approval, it would become the RFP standard for evaluating accident scenarios. In the meantime, MACCS has been designated as the safety analysis standard for such computations (Nelson, 1992; Zane, 1992). In the following sections,

the basis and capabilities of MACCS are discussed, the scenarios to be evaluated are presented, results from MACCS computations for postulated releases of WG Pu are presented, and recommendations are given for applying these results to any given application scenario.

2 MACCS BASIS AND CAPABILITIES

Although MACCS was developed at the SNL for the Nuclear Regulatory Commission (NRC) to aid in the evaluation of the consequences associated with postulated accidents at nuclear power plants, it has found general applicability elsewhere in the nuclear industry. Not only has RFP adopted it as the plant standard, it is also used by the Westinghouse Savannah River Company (WSRC), the Oak Ridge National Laboratories (ORNL), the INEL, and the Brookhaven National Laboratories (BNL), among others. It is an enhanced version of earlier NRC codes known as CRAC and CRAC2. MACCS is a "living" code, under continual refinement and enhancement. It has recently been upgraded to handle better some of the scenarios encountered at DOE facilities. This new "DOE" version is called MACCS2, Version 1.02. It is used as the basis for the computations discussed in this report. The MACCS2 code is available for several computer platforms; the one used here is the PC version.

Have MACCS and MACCS2 been verified and validated? In the sense of a formal and complete verification and validation based on the American National Standards Institute (ANSI) standard NQA-1 (ANSI, 1983), the answer is no. However, the MACCS code developers did extensive checking of the code as it was being developed. Furthermore, version 1.5.11 of MACCS was inspected line-by-line at the INEL and MACCS2 received limited verification at SNL prior to its dissemination to a beta-test group where additional verification was performed in conjunction with the code developers. MACCS has also been benchmarked against GENII (Peterson, *et al.*, 1992) and found to give comparable results, at least in applications such as evaluated in this report. GENII, in turn, was developed under a stringent quality assurance plan based on NQA-1 and has had extensive testing and peer review. It is probable that none of these atmospheric dispersion and consequence codes (MACCS, GENII, RSAC, or TRAC) will ever receive a complete validation, as that would require conducting numerous controlled experiments involving the release of known quantities of radionuclides, measuring the resultant concentrations and health effects, and compiling statistics from these experiments for comparison with the code results; such experiments would clearly be neither practical nor justifiable.

2.1 GAUSSIAN PLUME MODEL

The atmospheric transport and diffusion model used by MACCS/MACCS2 is the straight-line Gaussian-plume model. It assumes a flat terrain. As a plume travels downwind, it expands in both its horizontal and vertical dimensions. Its shape and size are defined by the width parameters σ_y and σ_z for the horizontal and vertical dimensions, respectively. (These σ 's correspond to standard deviations of a Gaussian distribution.) The variations of the σ 's with distance downwind depend upon atmospheric stability [as specified by the Pasquill stability classes, ranging from Class A (very unstable) through Class F (stable)] and are given by empirical formulas; the formulas used in MACCS/MACCS2 are from Tadmor and Gur (1969) with typographical error corrections provided by Dobbins (1979). These width parameters, along with wind speed and height of the plume, determine the dispersion factor, χ/Q , at any given

location relative to the plume. The product of the dispersion factor (s/m^3), amount of material released (C_i or B_q) in the plume, breathing rate (m^3/s), and dose conversion factor (rem/C_i or Sv/B_q), yields the dose (rem or Sv) to an individual. MACCS/MACCS2 allows the user to specify factors (multipliers) that widen the plume more than given by the Tadmor and Gur formulas. The horizontal multiplier is typically 1.0 (no change) but the vertical multiplier depends upon the roughness of the surface over which the plume travels. This σ_z multiplier has the form $(z_i/3 \text{ cm})^{0.2}$, where z_i is called the roughness length. For the entire area within 50 miles from RFP, this roughness length is 24 cm, on the average. This value, which is derived from the TRAC database, includes trees, buildings, grasslands, etc., and is appropriate for the population-consequence computations. However, for the MOI computations, in which the plume only travels over the grasslands on the RFP site, a more appropriate value for roughness length is 10 cm. Thus, in the computations given in this report, the σ_z multiplier is 1.52 for population computations and 1.27 for MOI computations.

MACCS/MACCS2 can handle single or multiple plumes for a given release scenario; a single long-duration plume may be broken up into several shorter-duration plumes, if desired. Once a plume leaves its source, it is assumed to travel in a straight line until it leaves the computational grid (where it no longer contributes to dose), even if the wind changes direction before the plume has left the grid. The direction of movement of the plume is the same as that of the wind at some user-specified point along the plume, usually chosen as the plume's head or midpoint. Each separate plume is allowed to travel in a different direction (according to the wind direction at the time of its release) but it is possible for the user to specify that all plumes for a given scenario travel in the same direction, namely that of the first plume. For the computations presented here, only a single plume was used. A plume is also allowed to meander, which effectively widens it. This decreases the dose a given individual would receive but spreads the plume over more individuals. The amount of meander is controlled by the duration of the plume. For the computations presented here, the duration was kept small in order to avoid plume meander, thus maximizing the dose to an individual while having only minimal effect on the latent cancer fatality rates to the population at large.

The assumption of flat terrain in MACCS is somewhat conservative for use at RFP because the direction of the most common winds, toward Denver, is a direction in which the terrain drops in altitude. Plumes released from RFP would therefore tend to be lifted above the terrain when moving toward Denver. However, the slope of the terrain from RFP to Denver is fairly gentle and so this effect is not as pronounced as it would be near a precipice, say. When slope changes are gentle, plumes tend to follow the terrain.

2.2 WEATHER DATA

2.2.1 MACCS Processing of Weather Data

Weather data needed by MACCS/MACCS2 can be input and handled in a variety of ways, depending upon the purpose of the computations. Each evaluation uses a sequence of 120

hours of weather data, or less if the plume leaves the computational grid before that time period is finished. There are five methods of handling weather data, two of which evaluate many 120 hour sequences from which statistical information is then derived and three of which evaluate a single weather sequence. The five methods are:

- a. One year of weather data is input, consisting of 8760 hourly values of wind speed, wind direction, precipitation, and stability class. Weather sequences start during every day of the year. The user specifies the number of times per day, up to four, from which starting times are randomly selected (*i.e.*, once during each six, eight, 12, or 24 hour period). Four starting times per day (1460 sequences for the year) represents a considerable computational load, but the resulting statistics for the year can be used with confidence.
- b. In order to minimize the computational load, the user can also request that MACCS/MACCS2 sort the hourly data into weather bins, which are then sampled in a statistically meaningful way; in this case, a hundred or so weather sequences would be sampled. The binning is performed according to the values of the four weather parameters: wind direction is sorted into 16 azimuth sectors centered on the 16 compass directions (north, north-northeast, northeast, ..., north-northwest); wind speed is sorted into as many as six categories, depending upon stability class; stability class is sorted into four categories (A/B, C/D, E, and F); and, precipitation is sorted into from 12 to 24 categories, depending upon user input. The frequency of weather falling into each (four dimensional) bin is then calculated. The resulting distribution is referred to in MACCS/MACCS2 as the bin wind rose. A Monte Carlo, Latin-Hypercube method is used to sample these bins for starting times.
- c. The user may specify that one particular weather sequence (using observed weather data) be evaluated, starting at a specified day and hour.
- d. The user may also create 120 hours of (artificial) weather data.
- e. Finally, the user may specify that the weather be constant.

The latter three methods are useful for investigating the effects of typical or unfavorable weather conditions or other conditions of particular interest.

2.2.2 Choosing Weather Conditions

In evaluating the consequences of accidents, it is common to analyze the scenario using either "typical" weather conditions, for realistic evaluations, or "unfavorable" weather conditions, when conservatism is needed. For MOI computations, these conditions are defined in terms of wind speed and stability class: "typical" is 4.5 m/s, Class D (DOE, 1992) and, "unfavorable" is 1 m/s, Class F (NRC, 1979). (See Section 3.5 for more discussion on this.) When using observed weather data, MACCS/MACCS2 derives statistics such as "mean", "50th percentile"

(median), "95th percentile", *etc.* Which statistical measures provided by MACCS/MACCS2 should be used to define "typical" and "unfavorable"?

"Typical" is usually represented by either the mean or the median. The mean has been frequently used in SARs and is commonly accepted as "typical". However, it is difficult to give a physical meaning to "mean". For example, if a quantity of interest, such as a dose at a given distance, has a bimodal frequency distribution and the mean happens to fall between the two peaks (modes), the mean value will occur infrequently; that could hardly be called "typical". A better statistic for "typical" is the median (50th percentile), as that has a precise meaning: 50% of the values are larger than the median and the other 50% are smaller. In the discussion to follow, the preferred definition of "typical" is the median; however, the mean will also be quoted to allow comparison with other consequence evaluations in which the mean is used.

NRC Regulatory Guide 1.145 (NRC, 1983) sets forth a methodology for selecting the unfavorable weather condition in terms of the dispersion factor, χ/Q : it is the greater of the overall 95th percentile χ/Q or the largest sector 99.5th percentile χ/Q , taking distance to the boundary into consideration. The overall 95th percentile χ/Q is defined as the value that is exceeded 5% of the time, or 438 hours (5% of 8760 hours), when considering all azimuth sectors combined. The sector 99.5th percentile χ/Q is defined as the value that is exceeded 0.5% of the time, or 44 hours (0.5% of 8760 hours), in any given sector. In the document that forms the basis of NRC Regulatory Guide 1.145 [*i.e.*, NUREG/CR-2260 (NRC, 1981)], it is shown that usually the overall 95th percentile is the more conservative estimate: the authors of NUREG/CR-2260 evaluated the weather conditions at 21 nuclear power plants throughout the United States and discovered that at all but one of the sites the overall 95th percentile χ/Q was larger than the largest sector 99.5th percentile χ/Q . In the discussion to follow, therefore, the overall 95th percentile values shall be considered representative of "unfavorable" conditions.

2.3 POPULATION DISTRIBUTION

The population to receive the dose from the plume must also be provided by the user. This can be specified as being uniform (with a user-specified population density) or it can be specified in a site file. In the latter, the distribution of population is given by a "population wheel", in which the azimuth sectors are the same as the 16 wind direction sectors and the radial distances are specified by the user. Typically, as in the SARs, the radial distances chosen are 1, 2, 3, 4, 5, 10, 20, 30, 40, and 50 miles. The consequences to on-site workers are ignored in this report by assigning zero population within the range intervals covering RFP, that is, within two miles from the plant center. The population distribution used for persons outside the plant boundaries is taken from Rocky Flats Risk Assessment Guide (RFRAG, 1992) increased by 18.6% to account for population growth since 1980 (the base period for the RFRAG). This growth corresponds to an annual growth rate of about 1.6% per year (the average for the 1980s for the greater Denver area) over 11 years, that is, the population is projected to 1991.

2.4 PLUME HANDLING

MACCS/MACCS2 allows the user to specify that the plume can travel outward from the source either "with rotation" or "without rotation", in accordance with NRC guidance during the development of MACCS that ensured the preservation of modeling capabilities incorporated in the CRAC and CRAC2 codes. "Without rotation" simply means that each plume travels only in its original direction, an approach that seems intuitively obvious. This yields one set of results for each weather sequence chosen, evaluating dose only to the population that would have been affected by that plume; these results then become part of the data base from which statistics are derived. The "with rotation" computations, which were used in the 1975 Reactor Safety Study (WASH-1400, 1975) and implemented in prior NRC consequence codes, are not as intuitive: they allow the plume to travel into all 16 sectors according to the frequencies given by the wind rose. This gives 16 sets of results, which are then used in the statistical calculations. This approach is useful if one is assuming constant weather conditions. For example, if one has only the wind rose, average wind speed, and average stability class, and desires to apply these data to the entire population, "with rotation" is appropriate. However, if one has a full year of hourly weather data, it is more difficult to justify the use of the "with rotation" option. There are two ways to implement "with rotation"; these are labeled "straight-line wind" and "wind shift". The former sends all plumes of a given release in the direction of the first plume; the latter sends each plume in the wind direction at the time of its release. For a single plume, as in this report, these two options compute equivalent results. If one is interested in plume centerline doses or risks, MACCS/MACCS2 requires that the "with rotation, straight-line wind" option be chosen; centerline doses and risks are not available for the more realistic "without rotation" computations. This has been partially remedied in MACCS2 by allowing the user to request output of the "peak" doses found on the spatial grid. These "peak" doses are slightly less than the centerline doses because the "peak" dose is defined as the average dose across the central portion of the Gaussian peak; the "central portion" is defined by user input and is typically one-seventh of the width of the sector, *i.e.*, $22.5^\circ/7 = 3.2^\circ$. For a wide plume, the centerline dose and "peak" dose are essentially identical; for a narrow plume (as with Class F stability), the "peak" dose will be a few percent smaller than the true centerline dose. Considering the other uncertainties in dose estimates, this difference can be ignored.

The user also specifies a number of other parameters that control the development of the plume. These include release height, plume duration, mixing layer height, building wake effects, and buoyancy. The mixing layer height represents a "cap", above which the plume is not allowed to rise. Building wake effects have been ignored for this report as the distances of interest are at and beyond the plant boundary, for which building wake effects have only a minor effect. Buoyancy provides a mechanism for hot plumes to rise quickly (at least initially) and pass over the heads of nearby individuals.

2.5 HEALTH EFFECTS

MACCS/MACCS2 computes both individual and population doses and the corresponding health effects. In MACCS2, the organs of interest are hard-wired into the code, six for acute health effects and 10 for lifetime health effects. The user specifies which of these organs to use in the computations, which radioisotopes to include (up to 150 are allowed out of a database of 825 isotopes), and which health effects to output (*e.g.*, Latent Cancer Fatalities - LCFs). The dose conversion factors are derived from the ICRP-26 (1977) and ICRP-30 (1979-82) reports. Two modules within MACCS/MACCS2 are of interest here. Module EARLY computes the doses received during the emergency phase of the accident, typically the first week, whereas module CHRONC computes the doses received later. Thus, EARLY deals with plume inhalation, cloudshine, groundshine, and resuspension inhalation during the emergency period, whereas CHRONC deals with long-term inhalation of resuspended particles, groundshine, and ingestion doses. For WG Pu, dose is dominated by inhalation (direct and resuspended particles), whereas ingestion gives a much smaller dose (0.2% of the resuspension inhalation dose at the most, see Section 4.2.1) and cloudshine and groundshine are negligible. In practical terms for Pu releases, the direct plume inhalation dose is given by EARLY and the resuspended-particle inhalation dose is given primarily by CHRONC, although EARLY does contribute a small amount to resuspension dose.

2.5.1 Ingestion Dose

In order to demonstrate that the ingestion dose is small, as claimed above, values of the food-chain transfer factors appropriate for Pu must be provided so that the resulting ingestion dose can be calculated. The ingestion computation involves such things as the amount of Pu falling on leaves, soil, and water, the transfer of the Pu into the food chain and eventually into man. The food ingestion model implemented in MACCS2 is based on the work of Prof. Ward Whicker and colleagues at Colorado State University and Bruce Napier and colleagues at Pacific Northwest Laboratory. These models were then synthesized and adapted into computer software developed by Mike Abbott and Art Rood of the INEL (Abbott and Rood, 1993). Most of the transfer factors are contained in a file provided with MACCS2 but the ones specific to a particular locale must be provided. For Colorado, these include the following:

- ▶ The user must provide the fraction of the area of each spatial element (range interval and azimuth sector) that is surface water used for drinking. For the portion of Colorado near RFP, drinking water comes almost entirely from lakes and nearly every lake is used as a source of drinking water. Therefore, the fraction of each spatial element that is lake was determined from maps.
- ▶ The water-ingestion factor (WINGF), the ratio of the amount of radioactive material ingested to the amount deposited in the water, must be specified. This was determined using the equation

$$\text{WINGF} = \text{WT} * \text{WC} * \text{P/D}$$

where WT is the fraction of the radionuclide that survives the water purification process, WC is the amount of water ingested per person per year, P is the number of persons consuming that water, and D is the total river discharge rate. (River discharge is needed because rivers feed the lakes.) According to the MACCS documentation, WT ranges from 0.1 to 1.0. A typical person drinks about one liter of water per day, or WC is about 400 liters per year. The population drinking this water is about two million persons. The river discharge rate is estimated by assuming that all the precipitation falling within 50 miles of RFP eventually ends up in the rivers. Assuming an average precipitation of about 50 cm/yr (slightly higher than the typical RFP precipitation rate, to account for the greater precipitation rates in the mountains), this yields $D = 1 \times 10^{13}$ liters/year. Thus, $WINGF = 8 \times 10^{-6}$ to 8×10^{-5} ; a value of 2×10^{-5} was chosen as representative. This method of determining WINGF follows the method given in Sprung, *et al.* (1990) and was confirmed through private communication with Dr. Jon Helton (Arizona State University), who determined the water-ingestion factors for other sites as given in the MACCS documentation.

- ▶ Also needed is the fraction of the land in each spatial element that is devoted to farming or pastures. This was derived from the TRAC database.
- ▶ The fraction of the farmland devoted to each type of crop must be specified. These values were derived from data given in Colorado Agricultural Statistics (CAS, 1992), which reported data for 1991. These are given in Table 2-1.

Table 2-1. Farmland Crop Shares for Colorado (1991)

CROP	FARMLAND SHARE
Pasture	0.173
Stored Forage	0.221
Grains	0.552
Legumes and Seeds	0.034
Green Leafy Veg	0.001
Roots and Tubers	0.019
Other Food Crops	0.000

See Section 4.2.1 for a discussion of the ingestion dose that results from the use of the above ingestion factors, where it is shown that ingestion accounts for less than 0.2% of the total population dose, depending upon the dry deposition velocity.

2.5.2 Whole Body Doses

In addition to the doses to the individual organs affected by plutonium, the whole body Effective Dose Equivalent (EDE) is of particular interest. By definition, EDE is the summation over all specified tissues or organs of the body of the products of dose equivalents received and their corresponding weighting factors. These terms are defined as follows:

- ▶ Dose equivalent is a measure of the damage done to a tissue or organ by radiation and includes both internal exposure (inhalation and ingestion) and external exposure (groundshine and cloudshine).
- ▶ The weighting factors represent the fraction of the total health risk resulting from uniform whole-body irradiation that could be attributed to that particular tissue or organ; these factors are between zero and one and their sum over all organs and tissues is one.

No time period is specified with dose equivalent, that is, it includes both short-term and long-term exposures. Long-term exposure can be attained in two ways: continual exposure to groundshine (gamma rays), usually a minor contributor; and, inhalation or ingestion of long half-life radionuclides that remain in the body for a long time, as for Pu.

A term similar to EDE is Committed Effective Dose Equivalent (CEDE), which is the predicted dose from internal exposures over the remaining life of the individual, normally taken to be 50 years for SARs or 70 years for EAs (NEPA, 1993); it does not include external exposures. Thus, CEDE is a subset of EDE. For the purposes of this report, EDE and CEDE are essentially the same, as the external exposures are so small. There is often a need to relate a calculated dose to limits specified in, say, DOE Orders or regulations from the NRC or the Environmental Protection Agency (EPA), which state these limits in terms of an annual exposure. It is important not to confuse the total EDE or CEDE with an annual exposure limit. In some documents (*e.g.*, Eckerman, *et al.*, 1988) the annual exposure limit should be compared with the full 50-year (or 70-year) committed dose and in other documents (*e.g.*, DOE, 1988) it should be compared with a one-year dose, such as the first-year dose. For ²³⁹Pu (the dominant isotope for the computations presented here), the first-year dose is 9% of the CEDE, based on the internal dose conversion factors used in MACCS2 for the 50-year commitment period, or 7% based on the 70-year commitment period.

2.5.3 Exposure Periods

The length of time a person is exposed to groundshine and resuspended particles, and may ingest food products produced in the exposed area, obviously plays a role in the dose this person

would get. This exposure period must be specified in MACCS2, in the CHRONC module. (In earlier versions of MACCS, this exposure period was hard-wired into the code and was set at one million years.) For the computations presented in this report, this period has been set to 50 years, to be conservative, as very few persons would remain in the exposed area for a longer period and most people would have moved away before then; potential future residents could conceivably ingest food products produced on the contaminated ground for more than 50 years but since ingestion plays such a minor role in the total dose (for WG Pu), this contribution can be ignored. For comparison, computations have also been made for a one-year exposure period as a one-year exposure period may be more realistic than 50. It was found that the resulting doses and health risks for a 50-year exposure are only a few percent higher than those of the one-year period, especially for the smaller deposition velocities. This is expected, as most of the dose is received during the first few weeks after the accident.

Do not confuse exposure period with commitment period. Exposure period refers to the length of time a person may continue to take radiation into the body (both external and internal) during and after plume passage whereas commitment period refers to the length of time a long-lived radioisotope may remain in the body once it is inhaled or ingested (internal only).

2.6 PROTECTION FACTORS

The dose received by an individual or population depends upon the degree of shielding provided by buildings and vehicles. Three sets of values need to be provided to MACCS/MACCS2, one for normal activities, one for sheltering activities, and one for evacuation activities. Each set provides shielding factors for inhalation, groundshine, cloudshine, and skin protection. The corresponding breathing rates need to be provided as well. The protection factors for the general public, used in Section 4.2, are given in Table 2-2. Because evacuation and sheltering activities are not considered for this report, only the "normal activities" values are shown. The protection factors were taken from the MACCS documentation. The breathing rate for a member of the general public is taken to be that of a "reference man" involved in light activity (Elder, *et al.*, 1988). The protection factors for the MOI, used in Section 4.1, were all set to one (no protection) and the breathing rate was set to 3.5×10^{-4} m³/s, a value appropriate for moderate activity as recommended by DOE-Standard 1027-92 (DOE, 1992).

A number of other possible computations available with MACCS/MACCS2 have been ignored for this report. These include the effects and costs of evacuation, sheltering, relocation, interdiction, and decontamination activities. For a complete, realistic evaluation of an accident, these options are important but for this report they are not included.

Table 2-2. Shielding Factors and Breathing Rate for Normal Activities

Inhalation Shielding	0.41
Cloud Shielding	0.75
Ground Shielding	0.33
Skin Protection	0.41
Breathing Rate (m ³ /s)	3.33×10^{-4}

2.7 OUTPUT

A number of different types of outputs of results are possible with MACCS/MACCS2. For a single weather sequence, including constant weather, it is usually of interest to output characteristics of the plume for a particular isotope, such as ²³⁹Pu. These include the dispersion factor (χ/Q) at ground level under the plume centerline, plume size (σ_y and σ_z), plume centerline height, plume centerline concentration, and ground centerline concentration, all as a function of distance. For a random sampling of weather sequences, or sampling from every day of the year, this output is usually suppressed as it is of lesser interest and the amount of output (one set for each weather sequence) is excessive. Plume centerline (ground level) doses and risks are also of interest; these are available only for the "straight-line wind with rotation" option. Health effects statistics are available for any range of distances; for this report, the full range out to 50 miles was used. The statistics generated include, if requested, the Complementary Cumulative Distribution Function (CCDF) for any consequence (dose or health effect), for any specified range interval. The CCDFs, which correlate a consequence to the probability of exceeding that consequence, are commonly used in SARs and related documents to generate risk curves. The results from the EARLY and CHRONC modules are output separately, as well as combined, and the long-term population dose is broken down into its separate contributors.

2.8 SCALABILITY OF RESULTS

Of particular importance for this report is the scalability of results: some results are scalable and others are not. An example of the latter is "prompt health effects", such as pneumonitis. These cannot be scaled as they depend upon thresholds: an organ dose less than its respective threshold leads to no prompt health effect whereas a dose above that threshold would give that health effect. For this report, prompt health effects are all zero because the doses received are below all prompt-effect thresholds. All of the isotopes of WG Pu have half-lives of many years and therefore the dose received by a person during the first few days will only be a tiny fraction of the lifetime dose. Accordingly, a prompt health effect requires a very large amount of WG Pu to be released. For example, in order for a person at the plant boundary (1900 meters) to get a dose large enough to cause pneumonitis (the first prompt health effect to

occur), an airborne release of about 100 kg of respirable WG Pu would be required. If there were such a large release of Pu, the affected population near RFP would be evacuated, and therefore the results of this report would not apply as this report assumes there is no evacuation.

Ingestion doses can be scaled by the amount of Pu released but not by the number of people in the population. This is because ingestion dose is received at the place of ingestion, which is not necessarily within the computational grid; population ingestion dose depends only upon the amount of crop or other food-product produced, not on the population within the computational grid. (In MACCS2, the ingestion dose to an *individual* consuming crops/meat/milk/etc. produced at a *specified* location can also be output.)

Inhalation, cloudshine, and groundshine doses are scalable according to the amount of Pu released; this is the basis upon which the usefulness of this report rests. Even though these doses are scalable, their corresponding health risks may or may not be scalable. MACCS2 uses stochastic risk factors, which convert doses into health risks, that are piecewise linear but may be discontinuous. (See the ICRP-60 (1991) for a discussion of this. For earlier versions of MACCS, a linear-quadratic model was used, which meant that only certain health risks were linearly scalable.) In the case of Pu, the only organs of importance for cancer risk are the lungs, liver, and bone surface (Abrahamson, *et al.*, 1993, and confirmed by private communication from Bobby Scott of DOE's Inhalation Toxicological Research Institute (ITRI), June 1993). For these three organs, the stochastic risk factors are all linear and not discontinuous. Therefore, the risks evaluated in this report are linearly scalable. The stochastic risk factors used for the computations presented here are taken from Abrahamson, *et al.* (1993), a NUREG report that specifically addresses the risk factors for alpha-emitters, including Pu. These are given in Table 2-3. In the discussion to follow, the use of this three-organ set of stochastic risk factors is referred to as the ITRI method. It should be noted that the use of these factors in MACCS2 yields larger cancer risks for Pu exposure than did earlier versions of MACCS, which were based on ICRP-26 (1977). In particular, the lung factor is about four times larger than before, although the bone skeleton factor is about the same as before; liver was not available in the earlier MACCS data. Note that Table 2-3 does not use the EDE to calculate cancer risk.

**Table 2-3. Stochastic Risk Factors
for Plutonium for Various Organs**

ORGAN	RISK FACTOR (LCF/Sv)
Bone Skeleton	6.0×10^{-5}
Lungs	8.0×10^{-3}
Liver	1.5×10^{-3}

For purposes of completeness, this report also makes note of the cancer risks based on the EDE, as recommended in ICRP-60 (1991) and adopted by NEPA (1993) for EAs. This stochastic risk factor is 5×10^{-2} LCF/Sv for the whole population or 4×10^{-2} LCF/Sv for adult workers. (The factor for the public is higher than for adult workers because the public consists of a mixture of individuals with varying degrees of resistance to hazardous materials, including children, the elderly, and the infirm.) The use of ICRP-60 factors is referred to in this report as the NEPA method. This gives a somewhat higher cancer incidence rate than when using the ITRI method, about 75% higher, as will be shown below. It would not be appropriate to add the ITRI (three organ) and NEPA (EDE, or whole body) method results together, as that would double-count the organs. Based on Bobby Scott's recommendation (private communication, June 1993), and the fact that the ICRP-60 recommendation is for low-LET (Linear Energy Transfer) radiation rather than high-LET radiation like alpha radiation, it is believed that the ITRI method is the more realistic of the two methods for WG Pu and is therefore the one emphasized in this report.

3 PARAMETERS USED IN EVALUATIONS

In this section, the scenarios evaluated in this report are defined by way of the parameters used in the evaluations. MACCS/MACCS2 requires a large number of input parameters. Those that are not specifically discussed (either in Section 2 or below) have been taken directly from the MACCS and MACCS2 documentation, that is, the suggested default values have been used. These were utilized in NRC's comprehensive evaluation of commercial power plant risks, NUREG-1150 (NRC, 1987).

3.1 CONDITIONS OF Pu RELEASE

For the computations presented in this report, one gram of respirable WG Pu is released over a 10 minute period. By "respirable" is meant that the particles are smaller than $10\text{ }\mu\text{m}$ in aerodynamic equivalent diameter (AED); the particle size distribution is wide and only those smaller than $10\text{ }\mu\text{m}$ AED are important for health effects. (As will be discussed below, the most common particle size is thought to be on the order of $1\text{ }\mu\text{m}$ for most accident scenarios.) The releases are ground based, which is appropriate for most releases considered in the RFP SARs and EAs. One set of computations is made for "without fire" and another for "with fire". The latter uses a rate of release of sensible heat¹ of 6×10^6 watts, a value typical of those used in SARs and related documents for a medium size fire (INEL, 1990).

3.2 ISOTOPIC MIX

The activities of the isotopic mix of the WG Pu is taken from the Rocky Flats Risk Assessment Guide (RFRAG, 1992) and is given in Table 3-1. The total activity is 1.52×10^{10} Bq/g-mix (0.412 Ci/g-mix); the alpha activity is 2.81×10^9 Bq/g-mix (0.076 Ci/g-mix) as ^{241}Pu is a beta emitter. The half-lives of these isotopes, $T_{1/2}$, which are hard-wired into MACCS2, are also shown, along with their corresponding decay constants, λ ($= (\ln 2)/T_{1/2}$). The mass fractions (g/g-mix) of these isotopes can be derived from the activity and decay constants from the expression

$$\text{mass fraction (g/g-mix)} = \text{activity} \frac{\mu}{\lambda N} \quad (1)$$

where μ is the atomic weight (g/mole), N is Avogadro's number (6.022×10^{23} atoms/mole), and the activity is in Bq/g-mix. The mass fractions derived from equation (1), as shown in Table 3-1, differ slightly from those given in the RFRAG because the half-lives used in the RFRAG

¹The sensible heat (also called enthalpy) of an air parcel is the sum of its internal (thermal) energy and the potential energy associated with its pressure and density. It is to be contrasted with latent heat and radiant heat.

differ slightly from those given in Table 3-1. The sum of the mass fractions, 0.99, is slightly less than the 1.00 it should be. This difference, which arises from round-off error and the slight differences in the half-lives between MACCS2 and the RFRAG, is so small it may be ignored.

Table 3-1. Isotopic Mix of Weapons Grade Plutonium

Isotope	Activity (Bq/g-mix)	Half-Life (years)	Decay Constant (s ⁻¹)	Mass Fraction (g/g-mix)
²³⁸ Pu	1.85×10^8	87.74	2.50×10^{-10}	2.92×10^{-4}
²³⁹ Pu	2.13×10^9	24,065	9.13×10^{-13}	9.26×10^{-1}
²⁴⁰ Pu	4.77×10^8	6,537	3.36×10^{-12}	5.66×10^{-2}
²⁴¹ Pu	1.24×10^{10}	14.4	1.53×10^{-9}	3.25×10^{-3}
²⁴² Pu	4.44×10^4	376,300	5.84×10^{-14}	3.06×10^{-4}
²⁴¹ Am	2.22×10^7	432.2	5.08×10^{-11}	1.75×10^{-4}

In MACCS2, up to five generations of decay products can be tracked. If certain decay products and their daughters would not contribute significantly to the doses received, that decay chain can be terminated by declaring that a certain daughter is "pseudo-stable". For the results presented in this report, the daughters of the isotopes given in Table 3-1 are declared pseudo-stable; these are ²³⁴U, ²³⁵U, ²³⁶U, ²³⁷U, ²³⁸U, and ²³⁷Np. (²⁴¹Am is also a daughter of ²⁴¹Pu but is not declared pseudo-stable.)

3.3 DOSE CONVERSION FACTORS

The dose conversion factors (DCFs) for the WG Pu isotopes are given in Appendix A and correspond to a 1 μ m (AED) particle size. Because SARs use a 50-year commitment period for CEDE and the EAs use 70 years, the DCFs are provided for both commitment periods. Both inhalation and ingestion DCFs are given. MACCS2 applies DCFs in an incremental fashion, the increments being the first day, then the next six days (to bring the sum to one week), and so forth to bring the sums to two weeks, 30 days, 200 days, one year, and finally the full period (50 years or 70 years). If one wished to see what the total DCF would be for a given time period, the increments up to and including that time period would have to be summed. The DCFs are applied incrementally to allow for decay of the isotope during those incremental time periods. This is important when dealing with isotopes that have short half-lives but is of lesser importance for the WG Pu isotopes as most of these have long half-lives. If only the full period (50 or 70 years) were specified, the inhalation dose conversion factors for EDE, weighted over

all the isotopes in WG Pu, would be 1.82×10^{-5} Sv/Bq (6.73×10^7 rem/Ci) for a 50-year commitment period or 2.27×10^{-5} Sv/Bq (8.41×10^7 rem/Ci) for 70 years. These numbers are obtained by summing the products of the activities in Table 3-1 and the corresponding DCFs for EDE in Appendix A.1 (50 year commitment) or A.2 (70 year) and dividing by the total activity (1.52×10^{10} Bq/g-mix, or 0.412 Ci/g-mix). Had the beta-emitter (^{241}Pu) not been included, these "effective" DCFs would have been about five times larger.

3.4 DEPOSITION

Both wet and dry deposition from the plume are accounted for. For wet deposition, the washout coefficient is taken from the MACCS documentation, namely,

$$\text{washout coefficient (s}^{-1}\text{)} = 9.5 \times 10^{-5} I^{0.8}$$

where I is the precipitation intensity in mm/hr.

Dry deposition is expressed in terms of a deposition velocity, V. Three values of V have been used: 1 cm/s, the value given in the MACCS documentation and appropriate for 4 μm (AED) particles; 0.1 cm/s, which is appropriate for 0.7 μm (AED) particles; and zero, the smallest possible value. [The above correlations between particle size and deposition velocity have been taken from Yamartino (1985) for particles of density 11.5 g/cm³ (the density of plutonium dioxide) and a surface roughness length of 10 cm; for larger roughness lengths, the corresponding particles sizes would be smaller.] For V = 0 cm/s, wet deposition has also been set to zero in order to examine the extreme case of no deposition from any mechanism. The number of MACCS2 runs for a given weather data set is thus six: [three deposition velocities] $\times$ [two buoyancy values (no fire and with fire)]. Which deposition velocity should be used in practice? The answer depends upon the scenario being evaluated. For most scenarios evaluated in SARs and EAs, the Pu is released as particles of PuO₂; for this form the average particle size is thought to be about 1 μm (AED) (DOE, 1990), for which V = 0.1 cm/s is appropriate.

In addition to the deposition velocity, the dry deposition rate is also proportional to the ground-level air concentration, which means that a lofted plume has considerably less dry deposition than does a plume that travels along the ground; this is especially noticeable during the early history of a lofted plume, when the ground-level air concentration is nearly zero.

3.5 RESUSPENSION

Resuspension modeling uses the values suggested in the MACCS documentation. The EARLY module uses a one-term resuspension model, having an initial value and a decay rate; the initial resuspension coefficient is fairly large ($10^4/\text{m}$) but it decays by a factor of ten after one week, the end of the emergency period normally specified for EARLY. This is appropriate for an area with high vehicular traffic, such as near RFP. The CHRONC module uses a three-

term resuspension model, having resuspension coefficients of $10^{-5}/\text{m}$, $10^{-7}/\text{m}$, and $10^{-9}/\text{m}$ with decay half-lives of 6 months, 5 years, and 50 years, respectively. Thus, the CHRONC resuspension starts with the same coefficient that was in effect at the end of the EARLY phase. Of course, for the no-deposition runs, there is no material deposited on the ground and therefore there can be no resuspension inhalation, groundshine, or ingestion doses; the CHRONC contributions are then all zero.

3.6 MAXIMUM OFFSITE INDIVIDUAL (MOI)

Regulatory documents do not give a clear, unambiguous, and consistent definition of MOI. Some documents (*e.g.*, 10 CFR 100, 1990) specify that this maximally exposed individual is at the plant boundary whereas others (*e.g.*, DOE, 1989) state the MOI is at whatever distance beyond the boundary gives the largest dose. The latter document (DOE Order 6430.1A) further states that ingestion should be included, but it also states that the individual remains at the location for not more than two hours, which is inconsistent with ingesting food products produced there. In an attempt to satisfy what appears to be the intent of these regulations, the following definition MOI is used in this report:

The Maximum Offsite Individual is defined as someone remaining outdoors at the location of the plume centerline for two hours. This person is unprotected (no shielding) and stands at the minimum distance of the plant boundary or beyond, whatever distance gives the highest dose. The dose received is from direct inhalation of the plume, cloudshine, and the portion of groundshine and resuspension inhalation that may arise during the first two hours after plume release.² Neither long-term exposure to groundshine and resuspension nor ingestion contribute to dose.

For this report, the plant boundary distance is taken as 1900 meters from the accident site, which is appropriate for an accident near the center of the plant. Only the EARLY computations are appropriate; the CHRONC computations are not included for this individual. Because the MOI is unshielded, all shielding factors are 1.0. A moderate breathing rate ($3.5 \times 10^{-4} \text{ m}^3/\text{s}$) is used, in keeping with DOE Standard 1027-92 (DOE, 1992) guidance.

Two sets of MOI computations are performed, one for unfavorable weather conditions, in order to maximize the consequences to this person, and another for typical weather conditions. Several guidance documents [such as NRC Regulatory Guide 3.35 (NRC, 1979)] define unfavorable conditions as consisting of a wind speed of 1 m/s and stability Class F. The corresponding unfavorable mixing layer height is 268 m, the annual average mixing height for Denver mornings (Holzworth, 1972), when the mixing layer height is the lowest. Typical

²In keeping with this definition, MACCS2 has been run assuming the MOI is evacuated instantaneously after two hours. The population computations, however, assume that nobody is evacuated.

weather conditions are defined by DOE Standard 1027-92 (DOE, 1992) as Class D stability and 4.5 m/s wind; the corresponding mixing layer height is set at 1000 m, a typical value.

The χ/Q values at 1900 m for both sets of weather conditions are shown in Table 3-2, for both "no fire" and "with fire". As stated earlier, these values depend upon the roughness length of the terrain over which the plume moves; for the grassland on RFP, this is 10 cm, which gives a σ_z expansion factor of 1.27.

Table 3-2. χ/Q (s/m³) and Distances for MOI Computations for Unfavorable and Typical Weather Conditions

Weather Condition: Stability, Wind Speed	NO FIRE		WITH 6 MW FIRE	
	χ/Q (s/m ³)	Distance (m)	χ/Q (s/m ³)	Distance (m)
Class F, 1 m/s	2.21×10^{-4}	1900	1.25×10^{-5}	5630
Class D, 4.5 m/s	1.09×10^{-5}	1900	3.00×10^{-6}	1900

Note that the typical weather conditions (Class D, 4.5 m/s) give a χ/Q considerably smaller than that for the unfavorable weather conditions (Class F, 1 m/s), about a factor of 20 for "no fire" and a factor of four for "with fire". For unfavorable weather conditions, the largest value of χ/Q for "with fire" occurs beyond the plant boundary, at about 5600 m, whereas for the more common weather conditions the largest value occurs at the plant boundary. This arises because for unfavorable conditions, the plume doesn't expand as rapidly, as compared to more typical conditions, and thus this lofted plume doesn't "touch ground" as quickly as does the lofted plume for typical conditions.

3.7 POPULATION CONSEQUENCES

In addition to the MOI consequence evaluations, the consequences to the general population (POP) out to 50 miles from RFP have also been evaluated. For the POP computations, both constant, unfavorable weather conditions (1 m/s, Class F) and three yearly meteorological data sets have been used. The constant weather case was included for illustrating the relative importance of deposition, plume lofting, and the contributions from the EARLY and CHRONC modules; the use of real (and variable) weather data makes it more difficult to separate these relative contributions.

The three yearly data sets were for the years of 1990, 1991, and 1992. These have been included in this report to illustrate the year-to-year variations in dose and risk. Because the year

1992 had the fewest data drop-outs, it is recommended that 1992 be used as the "reference" year. (In preparing the meteorological data sets for MACCS, data drop-outs were handled by assigning the previous "good" datum to the missing datum. On occasion, the drop-out period may be several hours. For 1992, data were missing for approximately 0.8% of the time.) A fourth data-year has also been analyzed but not shown here. This is for the June 1, 1989 - May 31, 1990 period. This is the data set used by Stone and Webster Engineering Corporation (SWEC) for many of the MACCS analyses they performed in support of various SAR efforts at RFP, such as the Building 707 rebaseline effort (SWEC, 1991; SWEC, 1992). The results from the SWEC data set are similar to those from 1990, as might be expected since the two periods had a five-month overlap. The SWEC data set is not recommended because of the numerous and lengthy data drop-out periods and because of certain other minor problems with the data. It should be pointed out, however, that the SWEC data set was the best available at the time of the SWEC analyses and did meet Nuclear Regulatory Commission (NRC) guidance regarding data quality.

In preparing the meteorological data file for input into MACCS/MACCS2, the stability class must be determined for each hour of the year. There are several methods that can be used to determine stability class. The one chosen for this report, and the one recommended for use at RFP, is given in an EPA report (EPA, 1987) and is referred to here as the EPA method; it is based on the variability of wind direction (σ_θ), wind speed, and whether it was daytime or nighttime. Two other methods have also been evaluated but not shown in this report. One is the method recommended in NUREG/CR-2300 (NRC, 1982) (referred to below as the NUREG method), which is based on both the vertical temperature gradient and wind speed. The other is taken from NRC Regulatory Guide 1.23 (NRC, 1972) (referred to below as the NRC method), which is based on the vertical temperature gradient only. The SWEC data set used the NRC method. The NUREG method is rejected because it creates a fictitious bimodal distribution of dispersion factor (χ/Q), a distribution that arises because of the arbitrary wind-speed ranges assigned to each stability class. The NRC method is rejected because the temperature-gradient-only approach is generally rejected today as being unrealistic (NRC, 1982). It is interesting to note, however, that the doses and health risks determined using these different methods are generally within 20% of each other in terms of average or median values; the 95th percentile values are even more nearly equal.

Statistical data for the dispersion factor at a distance of 1900 meters and at plume centerline, ground level for the year 1992 are given in Table 3-3. These data assume the plume is released at ground level. The stability classes were determined using the EPA method and the σ_y and σ_z were determined from the Tadmor and Gur (1969) formulas. For this computation, a roughness length of 10 cm was used, which gives a σ_z expansion factor of 1.27, to allow a direct comparison with Table 3-2. Comparison of Table 3-3 with 3-2 shows that:

- The 95th percentile χ/Q value using the 1992 data is about half of the corresponding constant-weather (Class F, 1 m/s) value used for the MOI computations; thus, Class F and 1 m/s is more conservative than the 95th percentile weather and corresponds more closely with the overall 99.5th percentile weather.

- ▶ The 95th percentile χ/Q value is an order of magnitude larger than the median value. In other words, the degree of conservatism in using "unfavorable" instead of "typical" is about a factor of ten.
- ▶ The Class D, 4.5 m/s χ/Q value is almost the same as the 1992 median value; this shows that the DOE-STD-1027-92 (DOE, 1992) recommendation to use Class D, 4.5 m/s as "typical" is indeed a good choice.
- ▶ The 1992 mean χ/Q value is about twice the median value and thus the use of mean in place of median would be more conservative.

**Table 3-3. Dispersion Factor Statistics at 1900 Meters
at Plume Centerline, Ground Level for Ground Level Release.
1992 RFP Data, EPA Stability Class Method, No Fire**

STATISTIC	χ/Q VALUE (s/m ³)
Arithmetic Mean	2.43×10^{-5}
Median	1.12×10^{-5}
95th Percentile	1.08×10^{-4}

Only the "no fire" values are shown in Table 3-3, as the "with fire" values are not output by MACCS2. For more details of the 1992 weather distribution, refer to Appendix B, which gives the bin wind rose for 1992, as well as the CCDF of χ/Q at 1900 meters, as determined by MACCS2. The CCDF in Appendix B, and the values given in Table 3-3, are based on a MACCS2 run that used four starting times (for the 120 hour weather sequences) from each day of the year, or 1460 starting times during the year.

3.8 RFP WEATHER DATA

A comment about the RFP weather data is in order here. For the weather data used in this report, the wind sensor on the RFP 61-meter meteorological tower had a starting speed of 0.9 m/s. Any speed less than this amount was reported as 0.9 m/s and must simply be interpreted as "calm". In the MACCS/MACCS2 weather data input file, this value of 0.9 m/s has been retained. This means that the most unfavorable atmospheric dispersion that can possibly be calculated with RFP weather data is for a wind speed of 0.9 m/s and Class F stability, which is only slightly worse than the NRC Regulatory Guide 3.35 (NRC, 1979) recommendation of 1 m/s.

It is possible, however, to have meteorological conditions that are worse than 0.9 m/s, Class F, in the sense of yielding a larger dose. This can happen if plume depletion is substantial. In this case, the CHRONC dose may exceed that of EARLY because the resuspension dose could exceed the direct-inhalation dose. It is often found that the actual "worst case" meteorology, as determined by MACCS or MACCS2, occurs for a weather sequence that includes a period of precipitation.

4 RESULTS AND DISCUSSION

For all of the computations performed here, both MOI and POP, the computational grid was the same: 16 azimuth sectors and 11 radial ranges. The ranges chosen were 200, 581, 3219, 4828, 6437, 8047, 16090, 32190, 48280, 64370, and 80470 meters; the third through final values are equal to 2, 3, 4, 5, 10, 20, 30, 40, and 50 miles and were chosen to coincide with the available population wheel data. The first two ranges were chosen to force the first and third intervals to be centered at 100 meters, the minimum range of applicability of the model, and 1900 meters, the distance of the nearest point on the plant boundary from a point near Building 707. There is no off-site population in the first three range intervals and, as stated above, the on-site population is not included in these computations; these initial intervals are included for computations of plume centerline doses to a hypothetical individual that may be temporarily present, such as the MOI. Doses to the on-site population will be treated in a separate report.

4.1 MOI COMPUTATIONS

MOI computations have been made for both unfavorable (1 m/s, Class F) and typical (4.5 m/s, Class D) weather conditions for all three dry deposition velocities. The individual is assumed to remain outdoors in the plume centerline for two hours. The duration of the plume passage was 10 minutes. The requested MACCS2 output was plume centerline doses to the skeleton, lungs, liver, and whole body (EDE). (Health risks are not usually required for the MOI but for completeness the corresponding LCFs were also output. Although these health risks are not reported here they may be calculated through the use of the stochastic risk factors given in Table 2-3.) The population distribution is unimportant for this computation. Because the weather conditions were constant, no CCDF can be computed. In order to output characteristics of the plume, a single isotope must be specified (^{239}Pu was chosen) and the "straight-line wind with rotation" option must be used. The results are summarized in Appendix C, which gives some of the plume characteristics (for ^{239}Pu) and centerline dose (summed over all the isotopes in WG Pu) as a function of distance; plots of the plume centerline whole-body doses (EDE) are also given. The MOI computations have been made both for "no fire" and "with 6 MW fire" and for both the 50-year and 70-year commitment periods; the 50-year commitment period is used in SARs and the 70-year period in EAs. Table 4-1 summarizes the results for 1900 meters for unfavorable weather conditions and Table 4-2 summarizes the results for typical conditions; the doses to the bone surface (skeleton), lungs, liver, and whole body (EDE) are given for both the 50-year and 70-year commitment periods. The data for these tables have been extracted from Appendix C, which gives the doses for the full range out to 50 miles; the variation of EDE with distance is also shown graphically in Appendix C, both for "no fire" and "with fire" for the 50-year commitment period.

Table 4-1. MOI Doses for Unfavorable Weather Conditions

INDIVIDUAL DOSE, PLUME CENTERLINE 1 gram WG Pu, 10 minute ground-level release, roughness length = 10 cm 1 m/s wind, Class F stability, mixing layer ht = 268 m				
DRY DEPOSITION VELOCITY (cm/s)	ORGAN	NO FIRE dose at 1900 m (Sv)	WITH 6 MW FIRE dose distance (Sv) (m)	
CENTERLINE DOSES (Sv), 50-YEAR COMMITMENT				
V = 0	SKELETON	2.28×10^{-1}	1.29×10^{-2}	5630
	LUNGS	7.27×10^{-2}	4.12×10^{-3}	5630
	LIVER	4.97×10^{-2}	2.82×10^{-3}	5630
	EDE	2.14×10^{-2}	1.21×10^{-3}	5630
V = 0.1	SKELETON	2.01×10^{-1}	1.28×10^{-2}	5630
	LUNGS	6.40×10^{-2}	4.08×10^{-3}	5630
	LIVER	4.38×10^{-2}	2.79×10^{-3}	5630
	EDE	1.88×10^{-2}	1.20×10^{-3}	5630
V = 1.0	SKELETON	7.05×10^{-2}	1.17×10^{-2}	4020
	LUNGS	2.25×10^{-2}	3.72×10^{-3}	4020
	LIVER	1.54×10^{-2}	2.54×10^{-3}	4020
	EDE	6.61×10^{-3}	1.10×10^{-3}	4020
CENTERLINE DOSES (Sv), 70-YEAR COMMITMENT				
V = 0	SKELETON	3.09×10^{-1}	1.75×10^{-2}	5630
	LUNGS	8.21×10^{-2}	4.65×10^{-3}	5630
	LIVER	6.21×10^{-2}	3.52×10^{-3}	5630
	EDE	2.68×10^{-2}	1.52×10^{-3}	5630
V = 0.1	SKELETON	2.72×10^{-1}	1.74×10^{-2}	5630
	LUNGS	7.23×10^{-2}	4.60×10^{-3}	5630
	LIVER	5.47×10^{-2}	3.48×10^{-3}	5630
	EDE	2.36×10^{-2}	1.50×10^{-3}	5630
V = 1.0	SKELETON	9.56×10^{-2}	1.58×10^{-2}	4020
	LUNGS	2.54×10^{-2}	4.20×10^{-3}	4020
	LIVER	1.92×10^{-2}	3.18×10^{-3}	4020
	EDE	8.28×10^{-3}	1.37×10^{-3}	4020

Table 4-2 MOI Doses for Typical Weather Conditions

INDIVIDUAL DOSE, PLUME CENTERLINE 1 gram WG Pu, 10 minute ground-level release, roughness length = 10 cm 4.5 m/s wind, Class D stability, mixing layer ht = 1000 m				
DRY DEPOSITION VELOCITY (cm/s)	ORGAN	NO FIRE dose at 1900 m (Sv)	WITH 6 MW FIRE dose (Sv)	distance (m)
CENTERLINE DOSES (Sv), 50-YEAR COMMITMENT				
V = 0	SKELETON	1.12×10^{-2}	3.10×10^{-3}	1900
	LUNGS	3.57×10^{-3}	9.87×10^{-4}	1900
	LIVER	2.44×10^{-3}	6.75×10^{-4}	1900
	EDE	1.05×10^{-3}	2.91×10^{-4}	1900
V = 0.1	SKELETON	1.11×10^{-2}	3.10×10^{-3}	1900
	LUNGS	3.52×10^{-3}	9.87×10^{-4}	1900
	LIVER	2.41×10^{-3}	6.75×10^{-4}	1900
	EDE	1.04×10^{-3}	2.91×10^{-4}	1900
V = 1.0	SKELETON	9.82×10^{-3}	3.08×10^{-3}	1900
	LUNGS	3.13×10^{-3}	9.80×10^{-4}	1900
	LIVER	2.14×10^{-3}	6.27×10^{-4}	1900
	EDE	9.21×10^{-4}	2.88×10^{-4}	1900
CENTERLINE DOSES (Sv), 70-YEAR COMMITMENT				
V = 0	SKELETON	1.52×10^{-2}	4.20×10^{-3}	1900
	LUNGS	4.03×10^{-3}	1.12×10^{-3}	1900
	LIVER	3.05×10^{-3}	8.44×10^{-4}	1900
	EDE	1.32×10^{-3}	3.64×10^{-4}	1900
V = 0.1	SKELETON	1.50×10^{-2}	4.20×10^{-3}	1900
	LUNGS	3.98×10^{-3}	1.11×10^{-3}	1900
	LIVER	3.01×10^{-3}	8.43×10^{-4}	1900
	EDE	1.30×10^{-3}	3.64×10^{-4}	1900
V = 1.0	SKELETON	1.33×10^{-2}	4.17×10^{-3}	1900
	LUNGS	3.53×10^{-3}	1.11×10^{-3}	1900
	LIVER	2.67×10^{-3}	8.37×10^{-4}	1900
	EDE	1.15×10^{-3}	3.61×10^{-4}	1900

A number of important and interesting observations can be made by examining these two tables and the tables and figures in Appendix C:

- The dependence of dose on dry deposition velocity for "no fire" is much greater for unfavorable conditions than for typical. These different dependencies arise because of the nature of the plumes, the "typical plume" being wider, deeper, and more rapidly moving than the "unfavorable plume". For "no fire", both plumes touch ground during their entire histories. The "unfavorable plume" is slower moving and for $V = 1.0$ cm/s deposits a significant portion of its contents on the ground as it moves, thus substantially decreasing the inhalation dose. The "typical plume", on the other hand, is faster moving, which provides less time for deposition.
- ▶ For "with fire" the dependence of dose on dry deposition velocity is weak for both weather conditions, especially for distances less than about 10 km.
- ▶ For unfavorable conditions and no fire, the $V = 0$ dose exceeds that of $V = 0.1$ cm/s by only about 13%. For the 50-year commitment, the EDE (or CEDE) at the plant boundary is about 2×10^{-2} Sv (2 rem) for the 50-year commitment and 2.5×10^{-2} Sv (2.5 rem) for the 70-year commitment. On the other hand, for $V = 1.0$ cm/s, the doses are nearly a factor of three smaller, less than one rem.
- ▶ For typical conditions, the MOI doses are considerably smaller than for unfavorable conditions, about 1×10^{-3} Sv (0.1 rem) for all deposition velocities for the 50-year commitment.
- The 70-year commitment doses are higher than those of the 50-year, as expected, but not by the same amount for each organ. The 70-year/50-year dose ratio is about 1.36 for the skeleton, 1.13 for the lungs, and 1.25 for the liver and EDE.

Recommendation for most Pu releases: Use the dose results for $V = 0.1$ cm/s, as the particle size is thought to be on the order of $1 \mu\text{m}$ (AED). For unfavorable conditions without fire, the MOI dose (EDE) is about 2×10^{-2} Sv (2 rem). For unfavorable conditions with fire, and for typical conditions without fire, the EDE is about 1×10^{-3} Sv (0.1 rem). And finally, for typical conditions with fire, the EDE is about 3×10^{-4} Sv (0.03 rem).

Although the 70-year commitment dose is about 25% higher than the 50-year commitment dose, this difference is less than the uncertainties in the model and parameters used in an evaluation and so, for most applications, may be ignored. The above recommendation applies to most accident scenarios evaluated at RFP, especially if the particle size distribution is unknown. If the particle size is known, then use that size, of course. For example, if the accident involves the release of dust from contaminated soil, the particle size would be larger and the results from $V = 1$ cm/s may be more appropriate.

4.2 POP COMPUTATIONS

The primary interest in population computations is in the predicted health effects, of which LCF is normally the principal health concern. The latent cancer risks have been computed within MACCS2 using the ITRI method. For purposes of comparison, the latent cancer risks using the NEPA method are also shown for some cases; these were obtained by multiplying the EDE values by 5×10^{-2} LCF/Sv (see Section 2.8).

A number of different yearly weather data sets have been used to investigate the year-to-year variations. First, however, the constant weather conditions are investigated.

4.2.1 POP, Constant Weather

The first POP computations presented are for unfavorable constant-weather conditions (1 m/s, Class F) and a 70-year commitment period, in order to illustrate the relative importance of deposition, plume lofting, and the relative contributions from the EARLY and CHRONC modules. (As stated earlier, the use of real data makes it more difficult to illustrate these differences.) In order to generate plume centerline doses and health risks, the "straight-line wind with rotation" option had to be chosen. The wind rose was assumed to be uniform. The differences between these computations and those of MOI (Section 4.1) are that these computations use a site file, which contains the population distribution, the CHRONC calculations are included, the shielding factors are different (see Table 2-2), and the roughness length is 24 cm instead of 10 cm. (Because of the difference in roughness length, the χ/Q values are smaller than in the MOI computations. Do not use the χ/Q values from POP for MOI.)

The resulting centerline risks are summarized in Appendix D, which gives plume characteristics and centerline risk from EARLY, CHRONC, and OVERALL as a function of distance; plots of the OVERALL plume centerline LCFs are also given. Table 4-3 gives the total expected latent cancer fatalities within 50 miles of RFP for these unfavorable conditions. These total LCF values are based on doses received by all people, not just those at the plume centerline, as in Tables 4-1 and 4-2. In this table, the ingestion contribution (included in CHRONC) is 0 to 0.2% of the CHRONC risk, depending on V and whether or not there was a fire; the remainder of the CHRONC risk is due to inhalation of resuspended particles. As an independent confirmation of this, Ostmeyer (1986) gives the ratio of Curies ingested to Curies deposited on the (food producing) ground as 2.8×10^{-6} for plutonium. Since one gram of weapons-grade plutonium corresponds to about 0.412 Ci (RFRAG, 1992), and the EDE dose conversion factor for Pu ingestion is about 5×10^4 rem/Ci for most of the Pu isotopes (see Appendix A), the total societal ingestion dose from ground deposition of the entire one gram of Pu would be about 0.06 rem; this assumes the entire one gram of Pu is deposited on food-producing ground, a very conservative assumption. This ingestion dose is about 0.18% of the inhalation dose (about 31 person-rem, median) to the population within 50 miles of RFP. Clearly, ingestion plays a very minor role in dose and risk.

The POP results presented in this section are intended primarily to give an understanding of the relative importance of direct inhalation vs inhalation of resuspended particles (as given in the EARLY and CHRONC modules), of dry deposition velocity, and of the presence or absence of fire. The actual LCF values presented should not be used in evaluations of postulated accidents as it is not realistic to assume that the entire population is given a dose that corresponds to a 1 m/s wind speed and class F stability; these values are, however, similar to the 95th percentile values obtained from real weather data.

Table 4-3: Population Risk, Unfavorable Conditions

LATENT CANCER FATALITIES TO 50 MILES 1 gram WG Pu, 10 minute ground-level release 50 year exposure, 70 year commitment mixing layer ht = 268 m 1 m/s wind, Class F stability roughness length = 24 cm first entry = ITRI method; second entry = NEPA method			
MODULE	DRY DEPOSITION VELOCITY (cm/s)		
	V = 0	V = 0.1	V = 1.0
NO FIRE			
EARLY	1.33×10^{-1} 2.32×10^{-1}	9.94×10^{-2} 1.74×10^{-1}	9.01×10^{-3} 1.57×10^{-2}
CHRONC	0 0	2.41×10^{-2} 4.24×10^{-2}	1.74×10^{-2} 3.07×10^{-2}
OVERALL	1.33×10^{-1} 2.32×10^{-1}	1.24×10^{-1} 2.16×10^{-1}	2.64×10^{-2} 4.64×10^{-2}
WITH 6 MW FIRE			
EARLY	1.07×10^{-1} 1.87×10^{-1}	9.79×10^{-2} 1.71×10^{-1}	5.02×10^{-2} 8.75×10^{-2}
CHRONC	0 0	2.37×10^{-2} 4.18×10^{-2}	9.80×10^{-2} 1.73×10^{-1}
OVERALL	1.07×10^{-1} 1.87×10^{-1}	1.22×10^{-1} 2.13×10^{-1}	1.48×10^{-1} 2.60×10^{-1}

The sensitivity of the results to dry deposition velocity and the presence or absence of fire is obvious from Table 4-3:

- ▶ For both "no fire" and "with fire", the number of LCFs due to EARLY decreases as dry deposition velocity increases. This is because an increase in deposition decreases the concentration in the plume, thus decreasing the inhalation dose and risk.
- ▶ Increasing the deposition also causes a greater portion of the dose and risk to shift from EARLY to CHRONC, primarily because inhalation of resuspended particles becomes more important and may exceed direct plume inhalation dose for large deposition rates.
- ▶ Plume depletion from dry deposition is much more important for "no fire" than "with fire". This is because for "no fire", the plume touches the ground for its entire history whereas for "with fire", the plume touches the ground only during the later stages of its history. This effect is sufficiently pronounced that the OVERALL dose and risk decreases with increasing deposition for "no fire" but increases with increasing deposition for "with fire".
- ▶ The increase in risk with increasing deposition for "with fire" is caused by the population distribution, in which the plume is lofted over the heads of the nearby residents, which are few, and touches ground farther out where the population is greater. For example, for $V = 0$ cm/s the "no fire" risk is greater than "with fire" because the "no fire" plume affects all the population, near and far, whereas the "with fire" plume affects mainly the more distant population. On the other hand, for $V = 1.0$ cm/s, the "with fire" risk is greater than the "no fire" risk because the "no fire" plume is more depleted than the "with fire" plume by the time it reaches the heavy population.

For brevity, cancer risks to individual organs have been omitted from both Table 4-3 and Appendix D. However, they were computed and an additional observation is of interest:

- ▶ Even though the bone surface (skeleton) dose is larger than the lung dose (see Table 4-1, for example), the lung cancer risk is higher than the bone cancer risk. This derives directly from the stochastic risk factors (Table 2-3), which give a much higher weighting to the lungs than to bone surface or liver. For example, for this POP computation for unfavorable weather conditions, no deposition, and a 70-year commitment period, the OVERALL LCF risk is 0.114 for lungs, 0.0161 for liver, and 0.00321 for bone surface, giving a total LCF of 0.133.

The general behavior noted above can also be expected to occur with observed weather data discussed in the following section, although the day-to-day variations in the weather tend to mask this tendency. It can also be noted that the number of LCFs using the NEPA method is about 75% higher than when using the (preferred) ITRI method. In the following section only the results from using the ITRI method are reported but the corresponding NEPA-method LCFs can be estimated by increasing the values shown by 75%.

4.2.2 POP, Observed Weather

For this set of computations, the MACCS2 option chosen was "Wind Shift Without Rotation". As explained earlier, "wind shift" means that each plume travels in the direction of the wind at the time of its release and continues in that direction until it leaves the computational grid. "Without rotation" means that only one set of results were obtained for each plume, according to the population affected by that plume. The plume was not rotated into all 16 azimuth sectors according to the wind rose. For this option, plume centerline doses and risks are not available as output.

The LCF CCDFs for $V = 0.1$ cm/s and a 70-year commitment from the MACCS2 computations for 1990, 1991, and 1992 weather data are given in Appendix E, along with two figures comparing the OVERALL CCDFs for the three years, one figure for "no fire" and the other for "with fire". The LCFs out to 50 miles for all three values of V are given in Tables 4-4, 4-5, and 4-6 for both 50-year and 70-year commitment periods. There are three entries in each cell in these tables; the first entry gives the median (50th percentile), which represents typical conditions, the second gives the mean, and the third gives the 95th percentile, which represents unfavorable conditions. Note that for the statistical data derived from yearly weather observations, one can't simply add the EARLY and CHRONC results (for the median or 95th percentile) to get the corresponding OVERALL result. For statistics derived from observed weather, EARLY and CHRONC each have their own distributions (CCDFs) and even though on a case-by-case basis the EARLY and CHRONC results are added to get the corresponding OVERALL value, the resulting OVERALL distribution has its own, and different, CCDF. The means, however, do add, that is, the sum of the mean EARLY LCF and mean CHRONC LCF equals the mean OVERALL LCF. The LCFs given in these tables and in Appendix E use the ITRI stochastic risk factors.

The general observations made for the constant weather conditions seem to hold for real data. The one notable difference is that the OVERALL number of LCFs increases with increasing dry deposition velocity for both "no fire" and "with fire", whereas for the constant weather conditions it decreased for "no fire" and increased for "with fire". The reason for this is obscured in the process of combining the results from many different weather scenarios.

Note the remarkable variation in the results from year to year! The median values are especially variable, having more than a factor of two variation from year to year for any dry deposition rate. The 95th percentile values don't show nearly as much variation, differing by less than 40% from year to year. Note also that the number of LCFs for the entire population is not very sensitive to whether or not there was a fire. The reason for this lies in the population distribution: the lofting of the plume over the heads of nearby residents affects only a small number of people. The exception to this is for the case of no deposition, in which case plume lofting does play an important role, especially for unfavorable weather conditions for 1992.

Table 4-4. Population Risk, 1990 Weather Data

LATENT CANCER FATALITIES TO 50 MILES 1 gram WG Pu, 10 minute ground-level release 1990 Meteorological Data, ITRI Method of Calculating LCFs Entries are Median (50th Percentile), Mean, and 95th Percentile Values of LCFs						
MODULE	NO FIRE			WITH 6 MW FIRE		
	V = 0.0 cm/s	V = 0.1 cm/s	V = 1.0 cm/s	V = 0.0 cm/s	V = 0.1 cm/s	V = 1.0 cm/s
LATENT CANCER FATALITIES, 50-YEAR COMMITMENT						
EARLY	5.87×10^{-3}	5.82×10^{-3}	4.24×10^{-3}	5.19×10^{-3}	5.25×10^{-3}	5.38×10^{-3}
	1.58×10^{-2}	1.53×10^{-2}	1.17×10^{-2}	1.35×10^{-2}	1.36×10^{-2}	1.29×10^{-2}
	7.43×10^{-2}	7.43×10^{-2}	4.36×10^{-2}	6.11×10^{-2}	6.11×10^{-2}	6.05×10^{-2}
CHRONC	0	1.57×10^{-3}	9.24×10^{-3}	0	1.38×10^{-3}	1.18×10^{-2}
	0	5.14×10^{-3}	2.43×10^{-2}	0	4.73×10^{-3}	2.70×10^{-2}
	0	1.99×10^{-2}	9.36×10^{-2}	0	1.99×10^{-2}	1.36×10^{-1}
OVERALL	5.87×10^{-3}	8.23×10^{-3}	1.39×10^{-2}	5.19×10^{-3}	7.08×10^{-3}	1.48×10^{-2}
	1.58×10^{-2}	2.05×10^{-2}	3.60×10^{-2}	1.35×10^{-2}	1.83×10^{-2}	3.99×10^{-2}
	7.43×10^{-2}	8.93×10^{-2}	1.38×10^{-1}	6.11×10^{-2}	7.64×10^{-2}	1.95×10^{-1}
LATENT CANCER FATALITIES, 70-YEAR COMMITMENT						
EARLY	6.62×10^{-3}	6.43×10^{-3}	5.49×10^{-3}	5.89×10^{-3}	5.95×10^{-3}	5.82×10^{-3}
	1.82×10^{-2}	1.76×10^{-2}	1.34×10^{-2}	1.55×10^{-2}	1.56×10^{-2}	1.48×10^{-2}
	7.43×10^{-2}	7.43×10^{-2}	5.67×10^{-2}	6.90×10^{-2}	6.90×10^{-2}	6.89×10^{-2}
CHRONC	0	1.80×10^{-3}	1.24×10^{-2}	0	1.61×10^{-3}	1.21×10^{-2}
	0	5.90×10^{-3}	2.79×10^{-2}	0	5.42×10^{-3}	3.10×10^{-2}
	0	2.20×10^{-2}	1.31×10^{-1}	0	2.18×10^{-2}	1.37×10^{-1}
OVERALL	6.62×10^{-3}	8.93×10^{-3}	1.57×10^{-2}	5.89×10^{-3}	8.07×10^{-3}	1.81×10^{-2}
	1.82×10^{-2}	2.35×10^{-2}	4.13×10^{-2}	1.55×10^{-2}	2.10×10^{-2}	4.58×10^{-2}
	7.43×10^{-2}	1.04×10^{-1}	1.68×10^{-1}	6.90×10^{-2}	9.16×10^{-2}	1.95×10^{-1}

Table 4-5. Population Risk, 1991 Weather Data

LATENT CANCER FATALITIES TO 50 MILES 1 gram WG Pu, 10 minute ground-level release 1991 Meteorological Data, ITRI Method of Calculating LCFs Entries are Median (50th Percentile), Mean, and 95th Percentile Values of LCFs						
MODULE	NO FIRE			WITH 6 MW FIRE		
	V = 0.0 cm/s	V = 0.1 cm/s	V = 1.0 cm/s	V = 0.0 cm/s	V = 0.1 cm/s	V = 1.0 cm/s
LATENT CANCER FATALITIES, 50-YEAR COMMITMENT						
EARLY	1.31×10^{-2}	1.30×10^{-2}	1.04×10^{-2}	1.04×10^{-2}	1.04×10^{-2}	1.01×10^{-2}
	2.26×10^{-2}	2.16×10^{-2}	1.60×10^{-2}	1.73×10^{-2}	1.71×10^{-2}	1.64×10^{-2}
	6.82×10^{-2}	6.57×10^{-2}	5.16×10^{-2}	5.85×10^{-2}	5.83×10^{-2}	5.56×10^{-2}
CHRONC	0	3.63×10^{-3}	2.13×10^{-2}	0	3.12×10^{-3}	2.26×10^{-2}
	0	8.38×10^{-3}	3.38×10^{-2}	0	7.38×10^{-3}	3.51×10^{-2}
	0	2.46×10^{-2}	1.06×10^{-1}	0	2.36×10^{-2}	1.25×10^{-1}
OVERALL	1.31×10^{-2}	1.95×10^{-2}	3.15×10^{-2}	1.04×10^{-2}	1.23×10^{-2}	3.11×10^{-2}
	2.26×10^{-2}	3.00×10^{-2}	4.98×10^{-2}	1.73×10^{-2}	2.45×10^{-2}	5.15×10^{-2}
	6.82×10^{-2}	9.74×10^{-2}	1.63×10^{-1}	5.85×10^{-2}	8.16×10^{-2}	1.68×10^{-1}
LATENT CANCER FATALITIES, 70-YEAR COMMITMENT						
EARLY	1.38×10^{-2}	1.42×10^{-2}	1.13×10^{-2}	1.10×10^{-2}	1.15×10^{-2}	1.17×10^{-2}
	2.60×10^{-2}	2.48×10^{-2}	1.84×10^{-2}	1.98×10^{-2}	1.96×10^{-2}	1.88×10^{-2}
	8.63×10^{-2}	8.48×10^{-2}	5.99×10^{-2}	6.45×10^{-2}	6.30×10^{-2}	5.83×10^{-2}
CHRONC	0	3.83×10^{-3}	3.02×10^{-2}	0	3.22×10^{-3}	2.81×10^{-2}
	0	9.61×10^{-3}	3.88×10^{-2}	0	8.46×10^{-3}	4.03×10^{-2}
	0	3.25×10^{-2}	1.40×10^{-1}	0	3.12×10^{-2}	1.50×10^{-1}
OVERALL	1.38×10^{-2}	2.15×10^{-2}	3.67×10^{-2}	1.10×10^{-2}	1.64×10^{-2}	4.09×10^{-2}
	2.60×10^{-2}	3.44×10^{-2}	5.72×10^{-2}	1.98×10^{-2}	2.81×10^{-2}	5.91×10^{-2}
	8.63×10^{-2}	1.10×10^{-1}	1.67×10^{-1}	6.45×10^{-2}	9.32×10^{-2}	1.99×10^{-1}

Table 4-6. Population Risk, 1992 Weather Data

LATENT CANCER FATALITIES TO 50 MILES 1 gram WG Pu, 10 minute ground-level release 1992 Meteorological Data, ITRI Method of Calculating LCFs Entries are Median (50th Percentile), Mean, and 95th Percentile Values of LCFs						
MODULE	NO FIRE			WITH 6 MW FIRE		
	V = 0.0 cm/s	V = 0.1 cm/s	V = 1.0 cm/s	V = 0.0 cm/s	V = 0.1 cm/s	V = 1.0 cm/s
LATENT CANCER FATALITIES, 50-YEAR COMMITMENT						
EARLY	6.09×10^{-3}	6.00×10^{-3}	4.67×10^{-3}	4.72×10^{-3}	4.96×10^{-3}	5.60×10^{-3}
	1.71×10^{-2}	1.63×10^{-2}	1.16×10^{-2}	1.19×10^{-2}	1.20×10^{-2}	1.14×10^{-2}
	8.48×10^{-2}	7.33×10^{-2}	5.10×10^{-2}	4.31×10^{-2}	4.33×10^{-2}	4.18×10^{-2}
CHRONC	0	1.77×10^{-3}	9.80×10^{-3}	0	1.53×10^{-3}	1.18×10^{-2}
	0	6.87×10^{-3}	2.48×10^{-2}	0	5.94×10^{-3}	2.51×10^{-2}
	0	2.55×10^{-2}	1.03×10^{-1}	0	1.68×10^{-2}	1.05×10^{-1}
OVERALL	6.09×10^{-3}	7.29×10^{-3}	1.55×10^{-2}	4.72×10^{-3}	6.40×10^{-3}	1.68×10^{-2}
	1.71×10^{-2}	2.32×10^{-2}	3.64×10^{-2}	1.19×10^{-2}	1.80×10^{-2}	3.66×10^{-2}
	8.48×10^{-2}	1.07×10^{-1}	1.48×10^{-1}	4.31×10^{-2}	7.52×10^{-2}	1.26×10^{-1}
LATENT CANCER FATALITIES, 70-YEAR COMMITMENT						
EARLY	6.81×10^{-3}	6.87×10^{-3}	6.11×10^{-3}	5.68×10^{-3}	5.88×10^{-3}	6.12×10^{-3}
	1.97×10^{-2}	1.88×10^{-2}	1.33×10^{-2}	1.37×10^{-2}	1.38×10^{-2}	1.31×10^{-2}
	1.04×10^{-1}	1.02×10^{-1}	5.40×10^{-2}	4.64×10^{-2}	4.64×10^{-2}	4.33×10^{-2}
CHRONC	0	2.01×10^{-3}	1.26×10^{-2}	0	1.75×10^{-3}	1.40×10^{-2}
	0	7.88×10^{-3}	2.84×10^{-2}	0	6.82×10^{-3}	2.88×10^{-2}
	0	2.63×10^{-2}	1.07×10^{-1}	0	2.27×10^{-2}	1.05×10^{-1}
OVERALL	6.81×10^{-3}	9.13×10^{-3}	1.71×10^{-2}	5.68×10^{-3}	7.55×10^{-3}	1.71×10^{-2}
	1.97×10^{-2}	2.66×10^{-2}	4.17×10^{-2}	1.37×10^{-2}	2.06×10^{-2}	4.19×10^{-2}
	1.04×10^{-1}	1.23×10^{-1}	1.84×10^{-1}	4.64×10^{-2}	8.00×10^{-2}	1.44×10^{-1}

Because of the year-to-year variations due to differences in meteorology, the expected number of LCFs from an accidental release of WG Pu should not be quoted to an accuracy greater than about a factor of two. Thus, for $V = 0.1$ cm/s, the total number of latent cancer fatalities to be expected within 50 miles of RFP from a one gram release of respirable WG Pu would be about 0.01 for typical weather conditions and about 0.1 for unfavorable weather conditions. The differences between the 50-year and 70-year commitments are smaller than the

year-to-year variations due to weather and would thus not materially affect the above-quoted figures; for example, even though the 70-year commitment risks are generally larger than the 50-year commitment risks, the 70-year risk for 1990 is slightly smaller than the 50-year risk for 1992 for $V = 0$ and 0.1 cm/s and no fire. Therefore, when using numbers from this report, scale these numbers according to amount of WG Pu released, using the full three-figure accuracy, then round the final results to one significant figure.

For completeness in this report, Appendix F gives the entire output from the MACCS2 run using 1992 meteorological data and $V = 0.1 \text{ cm/s}$. As can be seen, all of the input data are reproduced in the output except for the lengthy tables of weather data, dose conversion factors, and food ingestion parameters. The input for all of the other POP runs are identical except for the choice of input weather data file and dry deposition velocity. The MOI input data are likewise very similar, the differences being in the weather chosen, the shielding factors, and the roughness length chosen.

5 AGED PLUTONIUM

The above computations were made for the standard WG Pu mix given in the RFRAG (1992). However, RFP is no longer manufacturing nuclear components and therefore will no longer be receiving shipments of fresh WG Pu. (However, transition activities will require some reprocessing of Pu metals and residues, which may result in fresh WG Pu.) The WG Pu at RFP, as it ages, will change its relative isotopic make-up. In particular, ^{241}Pu has a relatively short half life (Table 3-1) of 14.4 years, decaying into ^{241}Am through beta decay. Over time, the ^{241}Pu activity will decrease and the ^{241}Am activity will increase. This section of the report evaluates the changes to the public consequences of an accidental release of an aged Pu mix.

5.1 THE AGED Pu ISOTOPIC MIX

Let $N_i(t)$ be the number of atoms of isotope i at time t in one gram of Pu mix and $N_i(0)$ be the number at time zero. If there is no production of this isotope through the decay of other isotopes, then the rate of change is simply proportional to the number of atoms present:

$$\frac{dN_i}{dt} = -\lambda_i N_i \quad (2)$$

where λ_i is the decay constant for that isotope. The solution to equation (2) is

$$N_i(t) = N_i(0) e^{-\lambda_i t} \quad (3)$$

This equation can be used for all of the WG Pu isotopes except ^{241}Am , which has a production term as well as a decay term:

$$\frac{dN_i}{dt} = -\lambda_i N_i + \lambda_{i-1} N_{i-1} \quad (4)$$

where, in this case, the subscript i refers to ^{241}Am and $i-1$ refers to ^{241}Pu . The solution to equation (4) is

$$N_i(t) = N_i(0) e^{-\lambda_i t} - N_{i-1}(0) \frac{\lambda_{i-1}}{\lambda_{i-1} - \lambda_i} (e^{-\lambda_{i-1} t} - e^{-\lambda_i t}) \quad (5)$$

The aging of ^{241}Pu and ^{241}Am is shown in Figure 5-1, which shows that ^{241}Am will build up, reach a peak, then slowly decay. The ^{241}Pu simply decays throughout this time period. The other isotopes have not been shown as they remain at nearly the same concentrations during this period. The mass fractions are shown in this figure rather than the values of N as the mass fractions are proportional to N and are of more immediate interest.

Figure 5-1. The time variation of ^{241}Pu and ^{241}Am over a 200 year time span.

The maximum amount of ^{241}Am will occur when $dN_i/dt = 0$, or, from equation (4), when $\lambda_i N_i = \lambda_{i-1} N_{i-1}$. Combining this with equation (5) gives an expression of the time, $t_{\max}$, at which this peak is reached:

$$t_{\max} = \frac{1}{\lambda_{i-1} - \lambda_i} \ln \left[\frac{N_{i-1}(0) \lambda_{i-1} \left(1 + \frac{\lambda_i}{\lambda_{i-1} - \lambda_i} \right)}{N_i(0) \lambda_i + N_{i-1}(0) \lambda_{i-1} \frac{\lambda_i}{\lambda_{i-1} - \lambda_i}} \right] \quad (6)$$

The initial numbers of atoms per g-mix, $N_i(0)$, are proportional to the mass fractions given in Table 3-1. Using the mass fractions and λ values from Table 3-1 yields

$$t_{\max} = 72.0 \text{ years} \quad (7)$$

Equation (5) can also be used to calculate the time in the past when there was no ^{241}Am , that is, when the WG Pu was fresh. This yields $t(\text{fresh}) = -1.1$ years. On this basis, the time from when the Pu was fresh to when the peak ^{241}Am is reached is 73.1 years.

Using the value of $t_{\max}$ (equation 7) in equations (3) and (5) yields the "aged" mass fractions given in Table 5-1. The corresponding activities, also shown in this table, are derived by inverting equation (1) in Section 3.2.

Table 5-1. Isotopic Mix of Aged (72.0 years) Weapons Grade Plutonium

Isotope	Aged Activity (Bq/g-mix)	Aged Mass Fraction (g/g-mix)
^{238}Pu	1.05×10^8	1.65×10^{-4}
^{239}Pu	2.13×10^9	9.24×10^{-1}
^{240}Pu	4.73×10^8	5.61×10^{-2}
^{241}Pu	3.87×10^8	1.02×10^{-4}
^{242}Pu	4.44×10^4	3.06×10^{-4}
^{241}Am	3.87×10^8	3.05×10^{-3}

By comparing Table 5-1 with 3-1 it is seen that the ^{239}Pu , ^{240}Pu , and ^{242}Pu abundances change very little over this 72-year period. However, ^{241}Pu decreases substantially, ^{241}Am increases substantially, as was seen in Figure 5-1, and ^{238}Pu decreases about 76%. The overall activity drops to 3.48×10^9 Bq/g-mix (0.094 Ci/g-mix), or about 23% of the original activity; the alpha activity, however, increases to 3.10×10^9 Bq/g-mix (0.084 Ci/g-mix), or an increase of about 10%. It is therefore expected that the doses and risks from exposure to aged WG Pu will be different from exposure to the standard WG Pu mix of isotopes. This is discussed in the next section.

5.2 CONSEQUENCE COMPUTATIONS WITH AGED WG Pu

The above activities have been used to repeat the MOI and POP calculations for $V = 0.1$ cm/s and a 50-year commitment period; the MOI computations used unfavorable weather conditions (Class F and 1 m/s) and POP used 1992 weather data. The results are shown in Tables 5-2 and 5-3.

Table 5-2. MOI Doses from Aged WG Pu

INDIVIDUAL DOSE, PLUME CENTERLINE $V = 0.1$ cm/s, 50-year commitment one gram <u>aged</u> WG Pu 10 minute ground-level release, roughness length = 10 cm 1 m/s wind, Class F stability, mixing layer ht = 268 m			
ORGAN	NO FIRE dose (Sv) at 1900 m	WITH 6 MW FIRE	
		dose (Sv)	distance (m)
SKELETON	2.42×10^{-1}	1.54×10^{-2}	5630
LUNGS	6.00×10^{-2}	3.82×10^{-3}	5630
LIVER	5.27×10^{-2}	3.36×10^{-3}	5630
EDE	2.07×10^{-2}	1.32×10^{-3}	5630

Comparing Table 5-2 with Table 4-1 shows that the MOI skeleton and liver doses will increase by about 20% during this 72 year period, and the EDE will increase by about 10%, but the lung dose will decrease by about 7%. The reason for this can be discerned by comparing the dose conversion factors in Appendix A for ^{239}Pu , the dominant isotope, which has only a minor change in abundance, with that of ^{241}Am , which substantially increases in abundance during this 72-year period. ^{241}Am has a relatively small dose conversion factor for lungs, but

large dose conversion factors for skeleton, liver, and EDE. Furthermore, ^{238}Pu , which decreases in activity by about 76% during this period, has DCFs similar to that of ^{239}Pu and tends to offset the increases caused by the increase in ^{241}Am . Because ^{241}Am is only a minor contributor to lung dose, the total lung dose will decrease a little; in contrast, it is a major contributor to skeleton and liver dose and to EDE and so these doses will show an increase. (^{241}Pu has small dose conversion factors for all these organs and is therefore a minor contributor for either the fresh or aged WG Pu mix of isotopes.)

Table 5-3. Population Risk, 1992 Weather Data, Aged WG Pu

LATENT CANCER FATALITIES TO 50 MILES one gram <u>aged</u> WG Pu, 10 minute ground-level release $V = 0.1 \text{ cm/s}$, 50-year commitment 1992 Meteorological data, TTRI Method of Calculating LCFs Entries are Median (50th Percentile), Mean, and 95th Percentile Values of LCFs		
MODULE	NO FIRE	WITH 6 MW FIRE
EARLY	5.86×10^{-3}	4.92×10^{-3}
	1.59×10^{-2}	1.17×10^{-2}
	7.09×10^{-2}	4.33×10^{-2}
CHRONC	1.77×10^{-3}	1.49×10^{-3}
	6.68×10^{-3}	5.78×10^{-3}
	2.55×10^{-2}	1.68×10^{-2}
OVERALL	7.29×10^{-3}	6.37×10^{-3}
	2.26×10^{-2}	1.75×10^{-2}
	1.07×10^{-1}	7.24×10^{-2}

Comparing Table 5-3 with Table 4-6 shows that the overall LCF risk has almost no change during the 72-year aging period. The reason that the risk change is less than that of the EDE is that cancer risk is dominated by the lung dose for Pu exposure and, as discussed above, the slight lung dose decrease balances the larger increases in the skeleton and liver doses during the aging period. The change in LCF risk is much smaller than the year-to-year variations in risk that arise from variations in meteorological conditions.

6 OTHER APPLICATIONS

Although the results presented here are specifically for the release of WG Pu, certain results are of wider interest. In particular, the χ/Q values may be used for accident analyses involving the release of hazardous chemicals, providing the atmospheric concentrations of these chemicals are small enough that they can be assumed to be well mixed with the atmosphere; this is the same assumption inherent in the use of MACCS/MACCS2 for radioactive materials. The χ/Q values for the MOI have already been given in Tables 3-2 and 3-3. For collocated-worker evaluations, the χ/Q values at 100 meters are often needed. These are given in Appendix C and are summarized in Table 6-1. For this person, a roughness length of 10 cm is appropriate. The values shown are without wake effects, which may be important, depending upon the site of the accident. The χ/Q values shown are therefore conservative; care should be exercised when using these numbers. If the plume duration is greater than 10 minutes, a plume expansion factor must be applied, which decreases the χ/Q values. The expansion factor takes the form

$$\text{expansion factor} = \left[\frac{\text{plume duration}}{\text{time base}} \right]^n$$

where the time base is typically taken as ten minutes and the exponent, n , is 0.2 for plume durations of one hour or less and 0.25 for greater durations. For a two hour plume, for example, the χ/Q values given in Tables 3-2, 3-3, and 6-1 should be divided by 1.86.

Table 6-1. χ/Q values (s/m^3) at 100 meters, 10 minute release, 10 cm roughness length

WEATHER CONDITIONS	NO FIRE	WITH 6 MW FIRE
Class F, 1 m/s wind	2.11×10^{-2}	7.11×10^{-26}
Class D, 4.5 m/s wind	1.24×10^{-3}	2.17×10^{-5}

Another χ/Q value of general interest is the population-weighted value. This can be found by dividing the population dose (person-Sv) for EDE for no deposition by the product of the breathing rate ($3.5 \times 10^{-4} \text{ m}^3/\text{s}$), EDE DCF for WG Pu ($1.82 \times 10^{-5} \text{ Sv/Bq}$), and activity of WG Pu ($1.52 \times 10^{10} \text{ Bq/g-mix}$). The population dose is taken from the MACCS2 computations for $V = 0.0 \text{ cm/s}$ from the output that corresponds to that given on page 42 of Appendix F. The results are summarized in Table 6-2 for the mean, median, and 95th percentile values; these are the χ/Q values integrated out to 50 miles from RFP and are based on 1992 weather. Note that a roughness length of 24 cm is appropriate for these computations.

Table 6-2. Population χ/Q values (person-s/m³), 10 minute release, 24 cm roughness length

STATISTIC	NO FIRE	WITH 6 MW FIRE
Mean	5.66×10^{-3}	3.93×10^{-3}
Median (50th percentile)	1.98×10^{-3}	1.60×10^{-3}
95th Percentile	2.69×10^{-2}	1.33×10^{-2}

It can be seen that the presence of a moderate fire decreases the population χ/Q values by a small amount, a factor of two or less, depending upon the statistic, which is a much smaller reduction than the corresponding reduction of the χ/Q values for the MOI. The reason for this relatively small effect is simply that the fire decreases the dose to the nearby population (the plume is lofted over their heads) but increases the dose to the more distant population; these effects tend to offset each other. For similar reasons, it is not appropriate to apply the plume expansion factor given above to the population χ/Q values. Plume meander has a very minor impact on the dose to the whole population; a meandering plume exposes more people but their individual exposures are less than when the plume does not meander.

When applying the values given in Table 6-2, note that the population is already included in them. Do not apply the population (about two million) again.

7 CONCLUSIONS AND RECOMMENDATIONS

It has been shown that for WG Pu, inhalation is the only exposure of importance. Ingestion will contribute less than 0.2% of the total dose, even using the most conservative dry deposition velocity evaluated here, $V = 1.0$ cm/s. Groundshine and cloudshine are trivial for WG Pu and may be ignored. The inhalation dose is primarily from direct inhalation of the plume material for small deposition rates but if the deposition rate is high and the exposure period is long the inhalation of resuspended particles can dominate the inhalation dose.

Unfavorable weather conditions are defined as Stability Class F and a wind speed of 1 m/s, if constant weather conditions are used, or the overall 95th percentile χ/Q if observed weather data are used. Typical weather conditions are defined as Stability Class D and a wind speed of 4.5 m/s, if constant weather conditions are used, or the median (50th percentile) χ/Q if observed weather are used. It was shown that Stability Class F and 1 m/s wind speed is overly conservative (by about a factor or two) for "unfavorable" when compared with the 95th percentile χ/Q from observed data and that the "typical" Stability Class D and 4.5 m/s wind speed compares very well with the median χ/Q from observed weather data.

The Maximum Offsite Individual is defined as a person remaining in the plume centerline at or beyond the plant boundary, whatever distance gives the greatest dose, for a period of two hours. For this person, the inhalation of resuspended particles contributes a very minor portion of the total dose. It is recommended that for a generic accident, in which the particle size distribution of the Pu is unknown, that a dry deposition velocity of $V = 0.1$ cm/s be used. The MOI doses for this recommended deposition rate are shown in Table 7-1. Note that these doses are given to only one significant figure, as more accuracy is unwarranted in light of the modeling and parameter uncertainties inherent in the assumptions upon which the computations are based. Note that the "no fire" doses are considerably larger than "with fire": a factor of 20 larger for unfavorable conditions and a factor of 3 or 4 larger for typical conditions. Also, the "typical" doses are considerably smaller than the "unfavorable" doses: a factor of 20 smaller for "no fire" and a factor of 3 or 4 smaller for "with fire". The values given in Table 7-1 are specifically for the 50-year commitment period but given the modeling and parameter uncertainties, these values can be used for the 70-year commitment period as well. (However, for an amount of WG Pu other than one gram, it is better to use the full three-digit figures from the appropriate tables in Section 4, scale them according to the amount of WG Pu released, then round the results to one significant figure.)

The number of latent cancer fatalities that may be expected in the population out to 50 miles from RFP may vary by a factor of two or more from one year to the next due to differences in meteorology. The recommended LCF values to use in postulated accident evaluations are given in Table 7-2, which is based on the results for a dry deposition velocity of 0.1 cm/s. These results are only given to one significant figure as the year-to-year variation is so large and the model and parameter uncertainties do not warrant greater accuracy. (As before, for an amount of WG Pu other than one gram, use the full three-digit figures from Section 4,

scale them according to the amount of WG Pu release, then round the results to one significant figure.)

Table 7-1. Recommended MOI Doses, EDE per Gram WG Pu

WEATHER CONDITION	NO FIRE	WITH 6 MW FIRE
Unfavorable (Class F, 1 m/s)	2×10^{-2} Sv (2 rem)	1×10^{-3} Sv (0.1 rem)
Typical (Class D, 4.5 m/s)	1×10^{-3} Sv (0.1 rem)	3×10^{-4} Sv (0.03 rem)

**Table 7-2. Recommended Latent Cancer Fatalities (LCFs)
per Gram WG Pu for Population Within 50 Miles of RFP**

WEATHER CONDITION	NO FIRE	WITH 6 MW FIRE
Unfavorable (95th Percentile)	0.1	0.1
Typical (Median)	0.01	0.01

The results presented here are valid only for relatively small, ground-level releases of WG Pu. Do not use them for releases from stacks, or kilogram-size releases, or releases of other radionuclides, such as from a criticality. Also, do not use these results for on-site dose evaluations, as the population distribution of workers and building wake effects play significant roles and these will vary from one accident site to the next.

Over the next several decades the amount of ^{241}Am in the WG Pu isotope mix will increase substantially as the ^{241}Pu decays. This will give rise to a slight increase in EDE and bone surface and liver doses but a slight decrease in lung dose. The overall LCF risk will have almost no change. The year-to-year variations in cancer risk, due to differences in meteorological conditions, are much larger than the change due to the aging of the WG Pu.

χ/Q values have been presented for applications other than for releases of WG Pu, for example, for use with chemical releases. In particular, χ/Q values have been presented for a

collocated worker 100 meters downwind of an accident site (no wake effects) and for the population within 50 miles of RFP.

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8 REFERENCES

- Abbott and Rood, 1993 M. L. Abbott and A. S. Rood, *COMIDA: A Radionuclide Food-Chain Model for Acute Fallout Deposition*, EGG-GEO-10367 (Rev 0), ITER/US/93/TE/SA-2, Idaho National Engineering Laboratory, EG&G Idaho, Inc., Idaho Falls, ID, November 1993.
- Abrahamson, *et al*, 1993 S. Abrahamson, M. A. Bender, B. B. Boecker, E. S. Gilbert, B. R. Scott, *Health Effects Models for Nuclear Power Plant Accident Consequence Analysis, Modification of Models Resulting From Addition of Effects of Exposure to Alpha-Emitting Radionuclides*, NUREG/CR-4214, Rev. 1, Part II (Scientific Bases for Health Effects Models), Addendum 2, LMF-136, Inhalation Toxicology Research Institute, Lovelace Biomedical and Environmental Research Institute, Albuquerque, NM, prepared for the U.S. Nuclear Regulatory Commission, Washington, DC, May 1993.
- ANSI, 1983 *Quality Assurance Program Requirements for Nuclear Power Plants, Supplement 3S-1, Supplementary Requirements for Design Control*, NQA-1, American National Standards Institute, New York, 1983.
- CAS, 1992 Colorado Agricultural Statistics, 1991 Preliminary, 1990 Revised, Colorado Agricultural Statistics Service, Lakewood, CO, July 1992.
- 10 CFR 100, 1990 *Reactor Site Criteria*, Title 10 Code of Federal Regulations Part 100, Office of the Federal Register, Washington, DC, January 1, 1990.
- Chanin, *et al.*, 1990 D. I. Chanin, J. L. Sprung, L. T. Ritchie, H-N Jow, and J. A. Rollstin, *MELCOR Accident Consequence Code System (MACCS). Volume 1: User's Guide; Volume 2: Model Description; Volume 3: Programmer's Reference Manual*, NUREG/CR-4691, Sandia National Laboratories, published by the U.S. Nuclear Regulatory Commission, Washington, DC, 1990.
- Dobbins, 1979 R. A. Dobbins, Atmospheric Motion and Air Pollution, John Wiley and Sons, New York, 1979.
- DOE, 1988 *Radiation Protection for Occupational Workers*, DOE Order 5480.11, U.S. Department of Energy, Washington, DC, December 21, 1988.

- DOE, 1989 *Site and Civil Engineering*, Division 2 of DOE Order 6430.1A, U.S. Department of Energy, Washington, DC, pp 2-3, 1989.
- DOE, 1990 *Environmental Assessment of Supercompactor and Repackaging Facility and TRU Waste Shredder*, DOE/EA-0432, U.S. Department of Energy, Rocky Flats Plant, Golden, CO, July 1990.
- DOE, 1992 *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, DOE Standard DOE-STD-1027-92, U.S. Department of Energy, Washington, DC, December 1992.
- Eckerman, *et al.*, 1988 K. F. Eckerman, A. B. Wolbarst, and A. C. B. Richardson, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*, **Federal Guidance Report No. 11**, U.S. Environmental Protection Agency, Washington, DC, 1988.
- Elder, *et al.*, 1986 J. C. Elder, J. M. Graf, J. M. Dewart, T. E. Buhl, W. J. Wenzel, L. J. Walker, and A. K. Stoker, *A Guide to Radiological Accident Considerations for Siting and Design of DOE Nonreactor Nuclear Facilities*, LA-10294-MS, Los Alamos National Laboratory, Los Alamos, NM, January 1986.
- EPA, 1987 *On-Site Meteorological Program Guidance for Regulatory Modeling Applications*, EPA-450/4-87-013, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC, June 1987.
- Hodgin, 1985 C. R. Hodgin, *The Terrain-Responsive Atmospheric Code (TRAC) for Plume Growth and Dispersion in Complex Terrain*, RFP-3683, Rockwell International, Golden, CO, April 3, 1985.
- Holzworth, 1972 G. C. Holzworth, *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States*, **EPA Report AP-101**, Environmental Protection Agency, Research Triangle Park, NC, p. 109, January 1972.
- ICRP-26, 1977 *Recommendations of the ICRP, Annals of the ICRP 1 (#3)*, **ICRP Publication 26**, published for the International Commission for Radiological Protection by Pergamon Press, Oxford, England, 1977.

- ICRP-30, 1979-82 *Limits for Intakes of Radionuclides by Workers, Annals of the ICRP 2 (#3-4), 4 (#3-4), 6 (#2-3), 7, 8 (#1-4), and 19 (#4), ICRP Publication 30, published for the International Commission for Radiological Protection by Pergamon Press, Oxford, England, 1979 - 1982.*
- ICRP-60, 1991 *1990 Recommendations of the International Commission of Radiological Protection, Annals of the ICRP 21 (#1-3), ICRP Publication 60, published for the International Commission for Radiological Protection by Pergamon Press, Oxford, England, 1991.*
- INEL, 1990 *Bounding Safety Assessment Document for the Rocky Flats Building 371 Decontamination and Decommissioning (D&D)/TRU Waste Transport, prepared by the Idaho National Engineering Laboratory for EG&G Rocky Flats, Inc., April 1990.*
- Kaplan and Garrick, 1981 S. Kaplan and B. J. Garrick, *On The Quantitative Definition of Risk, Risk Analysis 1*, pp 11 - 27, 1981.
- Napier, et al., 1988 B. A. Napier, D. L. Streng, R. A. Peloquin, and J. V. Ramsdell, *GENII - The Hanford Environmental Radiation Dosimetry Software System. Volume 1: Conceptual Representation; Volume 2: User's Manual; Volume 3: Code Maintenance Manual, PNL-6584, Pacific Northwest Laboratory, Richland, WA, 1988.*
- Nelson, 1992 DOE/RFO memorandum, WMED:MR:0427, from R. M. Nelson to J. O. Zane, Feb 26, 1992.
- NEPA, 1993 *Recommendations for the Preparation of Environmental Assessments and Environmental Impact Statements, NEPA report (no number), prepared for the Department of Energy, Office of NEPA Oversight, May 1993.*
- NRC, 1972 *Onsite Meteorological Programs, Regulatory Guide 1.23, U.S. Nuclear Regulatory Commission, Washington, DC, 1972.*
- NRC, 1979 *Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Plutonium Processing and Fuel Fabrication Plant, Regulatory Guide 3.35, U.S. Nuclear Regulatory Commission, Washington, DC, July 1979.*

- NRC, 1982 *PRA Procedures Guide, A Guide to the Performance of Probabilistic Risk Assessments for Nuclear Power Plants, Chapter 9: Environmental Transport and Consequence Analysis, NUREG/CR-2300, U.S. Nuclear Regulatory Commission, Washington, DC, 1982.*
- NRC, 1983 *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants, Regulatory Guide 1.145, U.S. Nuclear Regulatory Commission, Washington, DC, originally issued November 1982, reissued (Revision 1) February 1983.*
- NRC, 1987 *Reactor Risk Reference Document, NUREG-1150, U. S. Nuclear Regulatory Commission, Washington, DC (1987).*
- Ostmeyer, 1986 *R. M. Ostmeyer, An Approach to Estimating Food Ingestion Exposures for Nuclear Waste Transportation Accidents, SAND85-1722, TTC0572, UC-71, Sandia National Laboratories, Albuquerque, NM, February 1986.*
- Peterson, *et al.*, 1992 *V. L. Peterson, R. W. Patlovany, and G. A. Ennis, Comparisons Between MACCS and GENII, NSTR-017-92, EG&G Rocky Flats, Inc., Golden, CO, October 1992.*
- SWEC, 1991 *FSAR Review Team Report on Rocky Flats Plant Building 707, Volume 1: Main Report, prepared for EG&G Rocky Flats, Inc. by Stone and Webster Engineering Corporation, Boston MA, November 1991.*
- SWEC, 1992 *Addendum to the Building 707 FSAR Review Team Report, Building 707 Risk Assessment Review for Thermal Stabilization Mission and Other Non-Curtailed Operations, prepared for EG&G Rocky Flats, Inc. by Stone and Webster Engineering Corporation, Boston MA, December 2, 1992.*
- RFRAG, 1992 *Rocky Flats Risk Assessment Guide, prepared by Safety Analysis and Risk Assessment, Nuclear Safety Engineering, EG&G Rocky Flats, Inc., Golden, CO, September 30, 1992.*
- Sprung, *et al.*, 1990 *J. L. Sprung, J. A. Rollistin, J. C. Helton, and H-N. Jow, Evaluation of Severe Accident Risks, Volume 2: Quantification of Major Input Parameters, Part 7: MACCS Input, NUREG/CR-4551, Sandia National Laboratories, prepared for the U.S. Nuclear Regulatory Commission, Washington, DC, November 1990.*

- Tadmor and Gur, 1969 J. Tadmor and Y. Gur, *Analytical Expressions for the Vertical and Lateral Dispersion Coefficients in Atmospheric Diffusion*, Atmospheric Environment 3, Pergamon Press, p 688, 1969.
- WASH-1400, 1975 *Reactor Safety Study, An Assessment of Accident Risks in U.S. Commercial Nuclear Power Plants*, WASH-1400, NUREG-75/014, U. S. Nuclear Regulatory Commission, Washington, DC 1975.
- Wenzel, 1990 D. R. Wenzel, *RSAC-4, Radiological Safety Analysis Computer Program, Version 4.03, Interim Users Manual*, Westinghouse Idaho Nuclear Company, Inc., Idaho Falls, ID, April 10, 1990.
- Yamartino, 1985 R. J. Yamartino, *Atmospheric Pollutant Deposition Modeling*, Chapter 27 of Handbook of Applied Meteorology, edited by D. D. Houghton, John Wiley & Sons, New York, 1985.
- Zane, 1992 EG&G Rocky Flats, Inc. letter, 92-RF-5182, from J. O. Zane to T. Vaeth, May 8, 1992.

APPENDIX A

DOSE CONVERSION FACTORS

- A1. Inhalation, 50-year commitment
- A2. Inhalation, 70-year commitment
- A3. Ingestion, 50-year commitment
- A4. Ingestion, 70-year commitment

In the tables that follow, a column labeled TOTALS has been added as the last column. It is not used by MACCS2. It is the sum of the columns to the left and represents the DCF for the full 50-year or 70-year commitment period. It can be used for those isotopes that don't have appreciable decay or build-up during the 50- or 70-year commitment period.

A.1 INHALATION DOSE CONVERSION FACTORS, 50-YEAR COMMITMENT

*IDCFMAX Output of Dose Conversion Factors for:
 *INHALATION MACCS Select File was: selpu50.dat
 IDCFMAX INHALATION Calculation 09/08/93 09:17:48

22 organs (as for original IDCF code):

Adrenals Brain GI: LLI GI: SI GI: ST GI: ULI Kidneys Liver
 Lungs Muscle Ovaries Pancreas Marrow Skeleton Spleen Testes
 Thyroid Bladder others whl.body tot.body EDE

7 Number of Integration times, in days, as follows:

1 1 d
 2 7 d
 3 14 d
 4 30 d
 5 200 d
 6 365 d
 7 18250 d

6 Number of Nuclides Selected as follows:

Pu-238 Pu-239 Pu-240 Pu-241 Pu-242 Am-241 END

	DCF's			rem/ci				
	1 d	7 d	14 d	30 d	200 d	365 d	18250 d	TOTALS
Pu-238								
Adrenals	4.59E-01	9.02E-02	6.03E-02	1.37E-01	1.39E+00	1.26E+00	5.33E+01	5.67E+01
Brain	4.42E-01	4.66E-02	1.68E-02	3.87E-02	4.40E-01	4.67E-01	4.28E+01	4.43E+01
GI: LLI	9.23E+03	7.56E+04	1.43E+03	3.87E+02	3.55E+03	2.72E+03	1.04E+04	1.03E+05
GI: SI	2.41E+03	1.17E+03	1.53E+01	1.58E+01	1.47E+02	1.13E+02	4.43E+02	4.32E+03
GI: ST	2.84E+03	9.77E+02	1.54E+01	1.70E+01	1.58E+02	1.21E+02	4.72E+02	4.61E+03
GI: ULI	1.35E+04	2.20E+04	2.03E+02	1.57E+02	1.46E+03	1.12E+03	4.31E+03	4.27E+04
Kidneys	4.46E-01	5.31E-02	1.93E-02	4.41E-02	4.78E-01	4.72E-01	1.79E+01	1.94E+01
Liver	3.62E+03	3.39E+04	4.08E+04	9.77E+04	1.43E+06	2.09E+06	6.77E+08	6.81E+08
Lungs	2.29E+06	5.79E+06	5.92E+06	1.34E+07	1.29E+08	1.05E+08	9.21E+08	1.18E+09
Muscle	5.91E-01	4.23E-01	3.64E-01	8.20E-01	7.99E+00	6.64E+00	9.97E+01	1.17E+02
Ovaries	1.45E+02	1.36E+03	1.63E+03	3.91E+03	5.74E+04	8.41E+04	3.64E+07	3.65E+07
Pancreas	4.57E-01	6.42E-02	2.89E-02	6.58E-02	6.87E-01	6.41E-01	1.81E+01	2.00E+01
Marrow	1.07E+03	1.00E+04	1.20E+04	2.88E+04	4.23E+05	6.19E+05	2.45E+08	2.46E+08
Skeleton	1.34E+04	1.25E+05	1.50E+05	3.61E+05	5.29E+06	7.74E+06	3.06E+09	3.07E+09
Spleen	4.65E-01	1.01E-01	6.96E-02	1.57E-01	1.56E+00	1.34E+00	1.50E+01	1.87E+01
Testes	1.45E+02	1.36E+03	1.63E+03	3.91E+03	5.74E+04	8.41E+04	3.64E+07	3.65E+07
Thyroid	4.44E-01	5.01E-02	2.00E-02	4.58E-02	4.87E-01	4.64E-01	7.11E+00	8.62E+00
Bladder	1.53E-02	2.29E-02	8.23E-04	1.11E-03	1.20E-02	1.21E-02	6.65E-01	7.29E-01
others	1.09E+02	1.20E+01	4.80E+00	1.10E+01	1.17E+02	1.12E+02	1.85E+03	2.21E+03
whl.body	5.10E+04	1.35E+05	8.75E+04	1.96E+05	1.92E+06	1.61E+06	5.19E+07	5.59E+07
tot.body	3.30E+04	8.43E+04	8.62E+04	1.95E+05	1.90E+06	1.58E+06	4.11E+07	4.49E+07
EDE	2.77E+05	7.08E+05	7.19E+05	1.62E+06	1.58E+07	1.31E+07	2.81E+08	3.14E+08
Pu-239								
Adrenals	4.35E-01	9.48E-02	6.42E-02	1.45E-01	1.47E+00	1.31E+00	5.22E+01	5.57E+01
Brain	4.14E-01	4.40E-02	1.59E-02	3.67E-02	4.08E-01	4.18E-01	2.96E+01	3.10E+01
GI: LLI	8.64E+03	7.08E+04	1.34E+03	3.63E+02	3.33E+03	2.56E+03	1.00E+04	9.70E+04
GI: SI	2.26E+03	1.09E+03	1.44E+01	1.48E+01	1.38E+02	1.07E+02	4.26E+02	4.05E+03
GI: ST	2.66E+03	9.15E+02	1.44E+01	1.59E+01	1.48E+02	1.14E+02	4.57E+02	4.33E+03
GI: ULI	1.26E+04	2.06E+04	1.90E+02	1.47E+02	1.37E+03	1.06E+03	4.13E+03	4.01E+04
Kidneys	4.23E-01	6.29E-02	2.47E-02	5.63E-02	5.95E-01	5.69E-01	2.44E+01	2.61E+01
Liver	3.40E+03	3.18E+04	3.83E+04	9.17E+04	1.35E+06	1.97E+06	7.64E+08	7.67E+08
Lungs	2.15E+06	5.43E+06	5.56E+06	1.25E+07	1.21E+08	9.94E+07	9.46E+08	1.19E+09
Muscle	4.86E-01	2.26E-01	1.76E-01	3.98E-01	3.90E+00	3.29E+00	5.87E+01	6.72E+01
Ovaries	1.36E+02	1.27E+03	1.53E+03	3.67E+03	5.40E+04	7.94E+04	4.19E+07	4.20E+07
Pancreas	4.34E-01	7.99E-02	4.31E-02	9.77E-02	9.97E-01	9.01E-01	2.96E+01	3.22E+01
Marrow	1.00E+03	9.38E+03	1.13E+04	2.71E+04	3.98E+05	5.84E+05	2.80E+08	2.81E+08
Skeleton	1.25E+04	1.17E+05	1.41E+05	3.38E+05	4.98E+06	7.30E+06	3.50E+09	3.51E+09
Spleen	4.35E-01	9.26E-02	5.82E-02	1.32E-01	1.32E+00	1.15E+00	1.71E+01	2.03E+01
Testes	1.36E+02	1.27E+03	1.53E+03	3.67E+03	5.40E+04	7.94E+04	4.19E+07	4.20E+07
Thyroid	4.19E-01	5.55E-02	2.75E-02	6.26E-02	6.48E-01	5.97E-01	1.11E+01	1.29E+01
Bladder	1.81E-02	4.01E-02	1.36E-03	1.75E-03	1.89E-02	1.90E-02	2.41E+00	2.51E+00
others	1.02E+02	1.06E+01	3.90E+00	8.93E+00	9.64E+01	9.43E+01	1.48E+03	1.79E+03
whl.body	4.79E+04	1.27E+05	8.21E+04	1.84E+05	1.80E+06	1.52E+06	5.76E+07	6.14E+07
tot.body	3.10E+04	7.91E+04	8.09E+04	1.83E+05	1.78E+06	1.50E+06	4.52E+07	4.88E+07
EDE	2.60E+05	6.64E+05	6.75E+05	1.52E+06	1.48E+07	1.24E+07	3.08E+08	3.39E+08

Pu-240									
Adrenals	4.22E-01	6.36E-02	3.46E-02	7.87E-02	8.09E-01	7.38E-01	2.07E+01	2.29E+01	
Brain	4.14E-01	4.23E-02	1.41E-02	3.25E-02	3.56E-01	3.56E-01	7.98E+00	9.20E+00	
GI: LLI	8.61E+03	7.05E+04	1.33E+03	3.61E+02	3.31E+03	2.55E+03	9.95E+03	9.66E+04	
GI: SI	2.25E+03	1.09E+03	1.43E+01	1.48E+01	1.38E+02	1.06E+02	4.17E+02	4.03E+03	
GI: ST	2.65E+03	9.11E+02	1.43E+01	1.58E+01	1.47E+02	1.13E+02	4.47E+02	4.30E+03	
GI: ULI	1.26E+04	2.05E+04	1.89E+02	1.47E+02	1.37E+03	1.05E+03	4.11E+03	3.99E+04	
Kidneys	4.18E-01	5.09E-02	1.85E-02	4.22E-02	4.53E-01	4.41E-01	1.31E+01	1.45E+01	
Liver	3.40E+03	3.18E+04	3.83E+04	9.18E+04	1.35E+06	1.97E+06	7.64E+08	7.67E+08	
Lungs	2.15E+06	5.44E+06	5.56E+06	1.26E+07	1.21E+08	9.95E+07	9.47E+08	1.19E+09	
Muscle	4.19E-01	5.79E-02	2.36E-02	5.35E-02	5.60E-01	5.24E-01	9.56E+00	1.12E+01	
Ovaries	1.36E+02	1.27E+03	1.53E+03	3.68E+03	5.41E+04	7.95E+04	4.18E+07	4.20E+07	
Pancreas	4.23E-01	6.10E-02	2.93E-02	6.68E-02	6.92E-01	6.40E-01	1.70E+01	1.89E+01	
Marrow	1.00E+03	9.39E+03	1.13E+04	2.71E+04	3.99E+05	5.85E+05	2.80E+08	2.81E+08	
Skeleton	1.25E+04	1.17E+05	1.41E+05	3.39E+05	4.98E+06	7.31E+06	3.50E+09	3.51E+09	
Spleen	4.22E-01	6.04E-02	2.95E-02	6.71E-02	6.90E-01	6.29E-01	9.17E+00	1.11E+01	
Testes	1.36E+02	1.27E+03	1.53E+03	3.68E+03	5.41E+04	7.95E+04	4.18E+07	4.20E+07	
Thyroid	4.16E-01	4.79E-02	1.98E-02	4.53E-02	4.80E-01	4.56E-01	7.32E+00	8.79E+00	
Bladder	1.34E-02	2.29E-02	7.56E-04	9.48E-04	1.04E-02	1.05E-02	8.34E-01	8.93E-01	
others	1.01E+02	9.99E+00	3.37E+00	7.74E+00	8.48E+01	8.45E+01	1.10E+03	1.39E+03	
whl.body	4.80E+04	1.27E+05	8.22E+04	1.84E+05	1.81E+06	1.53E+06	5.76E+07	6.14E+07	
tot.body	3.10E+04	7.92E+04	8.10E+04	1.83E+05	1.79E+06	1.50E+06	4.52E+07	4.88E+07	
EDE	2.60E+05	6.65E+05	6.76E+05	1.53E+06	1.49E+07	1.24E+07	3.08E+08	3.39E+08	

Pu-241									
Adrenals	4.20E-04	1.25E-03	1.80E-03	6.37E-03	2.43E-01	4.85E-01	2.95E+02	2.95E+02	
Brain	3.19E-05	3.87E-05	5.97E-05	1.95E-04	8.09E-03	1.93E-02	7.40E+01	7.40E+01	
GI: LLI	4.38E+01	3.59E+02	6.82E+00	1.87E+00	1.84E+01	1.59E+01	1.33E+02	5.79E+02	
GI: SI	1.14E+01	5.54E+00	7.33E-02	7.68E-02	7.77E-01	6.91E-01	8.21E+01	1.01E+02	
GI: ST	1.35E+01	4.64E+00	7.41E-02	8.47E-02	9.39E-01	9.50E-01	1.04E+02	1.24E+02	
GI: ULI	6.38E+01	1.04E+02	9.67E-01	7.59E-01	7.58E+00	6.57E+00	1.46E+02	3.30E+02	
Kidneys	2.62E-04	6.18E-04	5.17E-04	1.78E-03	6.83E-02	1.42E-01	1.76E+02	1.77E+02	
Liver	1.80E-01	2.03E+00	4.77E+00	1.36E+01	8.27E+02	2.68E+03	1.64E+07	1.64E+07	
Lungs	1.12E+02	3.66E+02	5.49E+02	1.91E+03	6.91E+04	1.32E+05	1.15E+07	1.17E+07	
Muscle	2.42E-04	7.95E-04	8.00E-04	2.94E-03	1.16E-01	2.31E-01	9.38E+01	9.41E+01	
Ovaries	7.91E-03	8.47E-02	1.88E-01	5.40E-01	3.32E+01	1.08E+02	9.51E+05	9.51E+05	
Pancreas	4.39E-04	1.14E-03	1.43E-03	5.11E-03	1.98E-01	3.95E-01	2.39E+02	2.40E+02	
Marrow	5.42E-02	6.09E-01	1.40E+00	4.01E+00	2.45E+02	7.94E+02	6.26E+06	6.26E+06	
Skeleton	6.74E-01	7.61E+00	1.75E+01	5.01E+01	3.06E+03	9.93E+03	7.82E+07	7.83E+07	
Spleen	3.65E-04	1.02E-03	1.28E-03	4.62E-03	1.76E-01	3.44E-01	8.06E+01	8.11E+01	
Testes	7.23E-03	8.18E-02	1.88E-01	5.39E-01	3.32E+01	1.08E+02	9.51E+05	9.51E+05	
Thyroid	1.48E-04	4.26E-04	6.53E-04	2.31E-03	8.61E-02	1.68E-01	5.75E+01	5.78E+01	
Bladder	2.45E-04	1.10E-03	4.30E-05	5.38E-05	2.13E-03	5.09E-03	2.09E+01	2.09E+01	
others	5.48E-03	1.59E-03	1.45E-03	5.50E-03	2.29E-01	4.76E-01	2.19E+02	2.19E+02	
whl.body	2.51E+00	8.26E+00	8.15E+00	2.81E+01	1.03E+03	2.03E+03	1.13E+06	1.14E+06	
tot.body	2.03E+00	6.50E+00	8.04E+00	2.79E+01	1.02E+03	1.99E+03	8.55E+05	8.58E+05	
EDE	2.14E+01	7.28E+01	6.73E+01	2.33E+02	8.48E+03	1.65E+04	5.70E+06	5.73E+06	

Pu-242

Adrenals	4.09E-01	7.90E-02	5.21E-02	1.18E-01	1.21E+00	1.09E+00	5.21E+01	5.51E+01
Brain	3.94E-01	4.14E-02	1.48E-02	3.41E-02	3.87E-01	4.09E-01	4.12E+01	4.25E+01
GI: LLI	8.22E+03	6.74E+04	1.27E+03	3.45E+02	3.17E+03	2.44E+03	9.52E+03	9.23E+04
GI: SI	2.15E+03	1.04E+03	1.37E+01	1.41E+01	1.32E+02	1.01E+02	4.05E+02	3.86E+03
GI: ST	2.53E+03	8.70E+02	1.37E+01	1.51E+01	1.41E+02	1.09E+02	4.31E+02	4.11E+03
GI: ULI	1.20E+04	1.96E+04	1.81E+02	1.40E+02	1.30E+03	1.00E+03	3.93E+03	3.81E+04
Kidneys	3.97E-01	4.81E-02	1.76E-02	4.01E-02	4.35E-01	4.29E-01	1.82E+01	1.96E+01
Liver	3.23E+03	3.02E+04	3.64E+04	8.71E+04	1.28E+06	1.87E+06	7.26E+08	7.29E+08
Lungs	2.04E+06	5.16E+06	5.28E+06	1.19E+07	1.15E+08	9.44E+07	8.99E+08	1.13E+09
Muscle	5.11E-01	3.38E-01	2.87E-01	6.47E-01	6.32E+00	5.28E+00	9.02E+01	1.04E+02
Ovaries	1.29E+02	1.21E+03	1.46E+03	3.49E+03	5.13E+04	7.54E+04	3.98E+07	3.99E+07
Pancreas	4.07E-01	5.85E-02	2.70E-02	6.14E-02	6.39E-01	5.96E-01	1.89E+01	2.07E+01
Marrow	9.53E+02	8.91E+03	1.07E+04	2.57E+04	3.78E+05	5.55E+05	2.66E+08	2.67E+08
Skeleton	1.19E+04	1.11E+05	1.34E+05	3.21E+05	4.73E+06	6.94E+06	3.33E+09	3.34E+09
Spleen	4.13E-01	8.70E-02	5.85E-02	1.32E-01	1.32E+00	1.14E+00	1.41E+01	1.73E+01
Testes	1.29E+02	1.21E+03	1.46E+03	3.49E+03	5.13E+04	7.54E+04	3.98E+07	3.99E+07
Thyroid	3.95E-01	4.52E-02	1.84E-02	4.21E-02	4.47E-01	4.27E-01	7.12E+00	8.49E+00
Bladder	1.38E-02	2.17E-02	7.56E-04	9.91E-04	1.08E-02	1.09E-02	7.79E-01	8.37E-01
others	9.66E+01	1.05E+01	4.15E+00	9.48E+00	1.01E+02	9.79E+01	1.72E+03	2.04E+03
whl.body	4.55E+04	1.20E+05	7.80E+04	1.75E+05	1.71E+06	1.45E+06	5.47E+07	5.83E+07
tot.body	2.94E+04	7.51E+04	7.68E+04	1.73E+05	1.69E+06	1.42E+06	4.29E+07	4.64E+07
EDE	2.47E+05	6.31E+05	6.41E+05	1.45E+06	1.41E+07	1.17E+07	2.93E+08	3.22E+08

Am-241

Adrenals	1.77E+01	3.06E+01	2.95E+01	6.34E+01	5.15E+02	4.25E+02	3.07E+04	3.18E+04
Brain	8.71E+00	3.54E+00	3.42E+00	7.99E+00	9.41E+01	9.67E+01	8.64E+03	8.85E+03
GI: LLI	7.62E+03	6.79E+04	2.78E+03	3.04E+03	1.11E+04	1.10E+03	5.07E+03	9.86E+04
GI: SI	2.06E+03	1.21E+03	7.75E+01	1.35E+02	5.73E+02	1.62E+02	9.19E+03	1.34E+04
GI: ST	2.43E+03	1.02E+03	8.84E+01	1.59E+02	6.70E+02	1.81E+02	9.56E+03	1.41E+04
GI: ULI	1.12E+04	2.04E+04	7.72E+02	1.25E+03	4.66E+03	5.97E+02	1.29E+04	5.18E+04
Kidneys	1.35E+01	1.66E+01	1.26E+01	2.82E+01	2.85E+02	2.73E+02	2.00E+04	2.06E+04
Liver	6.59E+04	6.23E+05	7.61E+05	1.85E+06	2.52E+07	2.76E+07	1.98E+09	2.04E+09
Lungs	2.15E+06	5.54E+06	5.25E+06	1.04E+07	4.05E+07	4.51E+06	6.13E+05	6.90E+07
Muscle	1.40E+01	1.85E+01	1.25E+01	2.59E+01	1.74E+02	1.19E+02	8.89E+03	9.25E+03
Ovaries	2.65E+03	2.50E+04	3.04E+04	7.42E+04	1.01E+06	1.11E+06	1.11E+08	1.14E+08
Pancreas	1.85E+01	2.83E+01	2.44E+01	5.23E+01	4.25E+02	3.50E+02	2.50E+04	2.59E+04
Marrow	1.95E+04	1.84E+05	2.25E+05	5.47E+05	7.47E+06	8.20E+06	7.39E+08	7.56E+08
Skeleton	2.43E+05	2.30E+06	2.81E+06	6.84E+06	9.34E+07	1.02E+08	9.24E+09	9.45E+09
Spleen	1.61E+01	2.03E+01	1.61E+01	3.27E+01	1.78E+02	8.90E+01	6.11E+03	6.46E+03
Testes	2.64E+03	2.49E+04	3.04E+04	7.42E+04	1.01E+06	1.11E+06	1.11E+08	1.14E+08
Thyroid	1.11E+01	9.10E+00	8.44E+00	1.74E+01	1.07E+02	6.42E+01	5.13E+03	5.35E+03
Bladder	4.46E+00	2.06E+01	1.67E+00	2.99E+00	2.99E+01	2.88E+01	2.46E+03	2.55E+03
others	1.98E+03	2.55E+02	1.18E+02	2.44E+02	1.27E+03	4.14E+02	2.15E+04	2.58E+04
whl.body	5.09E+04	1.57E+05	1.16E+05	2.46E+05	1.89E+06	1.49E+06	1.15E+08	1.19E+08
tot.body	3.53E+04	1.04E+05	1.04E+05	2.20E+05	1.55E+06	1.13E+06	8.27E+07	8.58E+07
EDE	2.73E+05	8.05E+05	7.94E+05	1.64E+06	1.03E+07	6.53E+06	5.13E+08	5.33E+08

A.2 INHALATION DOSE CONVERSION FACTORS, 70-YEAR COMMITMENT

*IDCFMAX Output of Dose Conversion Factors for:

*INHALATION MACCS Select File was: selpu70.dat

IDCFMAX INHALATION Calculation 09/08/93 09:21:27

22 organs (as for original IDCF code):

Adrenals	Brain	GI: LLI	GI: SI	GI: ST	GI: ULI	Kidneys	Liver
Lungs	Muscle	Ovaries	Pancreas	Marrow	Skeleton	Spleen	Testes
Thyroid	Bladder	others	whl.body	tot.body	EDE		

7 Number of Integration times, in days, as follows:

1	1 d
2	7 d
3	14 d
4	30 d
5	200 d
6	365 d
7	25550 d

6 Number of Nuclides Selected as follows:

	Pu-238	Pu-239	Pu-240	Pu-241	Pu-242	Am-241	END	
	DCF's				rem/ci			
	1 d	7 d	14 d	30 d	200 d	365 d	25550 d	TOTALS
Pu-238								
Adrenals	4.59E-01	9.02E-02	6.03E-02	1.37E-01	1.39E+00	1.26E+00	6.22E+01	6.56E+01
Brain	4.42E-01	4.66E-02	1.68E-02	3.87E-02	4.40E-01	4.67E-01	5.30E+01	5.45E+01
GI: LLI	9.23E+03	7.56E+04	1.43E+03	3.87E+02	3.55E+03	2.72E+03	1.04E+04	1.03E+05
GI: SI	2.41E+03	1.17E+03	1.53E+01	1.58E+01	1.47E+02	1.13E+02	4.45E+02	4.32E+03
GI: ST	2.84E+03	9.77E+02	1.54E+01	1.70E+01	1.58E+02	1.21E+02	4.74E+02	4.61E+03
GI: ULI	1.35E+04	2.20E+04	2.03E+02	1.57E+02	1.46E+03	1.12E+03	4.31E+03	4.27E+04
Kidneys	4.46E-01	5.31E-02	1.93E-02	4.41E-02	4.78E-01	4.72E-01	2.05E+01	2.20E+01
Liver	3.62E+03	3.39E+04	4.08E+04	9.77E+04	1.43E+06	2.09E+06	8.03E+08	8.06E+08
Lungs	2.29E+06	5.79E+06	5.92E+06	1.34E+07	1.29E+08	1.05E+08	1.02E+09	1.28E+09
Muscle	5.91E-01	4.23E-01	3.64E-01	8.20E-01	7.99E+00	6.64E+00	1.14E+02	1.31E+02
Ovaries	1.45E+02	1.36E+03	1.63E+03	3.91E+03	5.74E+04	8.41E+04	4.77E+07	4.78E+07
Pancreas	4.57E-01	6.42E-02	2.89E-02	6.58E-02	6.87E-01	6.41E-01	2.05E+01	2.24E+01
Marrow	1.07E+03	1.00E+04	1.20E+04	2.88E+04	4.23E+05	6.19E+05	3.10E+08	3.11E+08
Skeleton	1.34E+04	1.25E+05	1.50E+05	3.61E+05	5.29E+06	7.74E+06	3.88E+09	3.89E+09
Spleen	4.65E-01	1.01E-01	6.96E-02	1.57E-01	1.56E+00	1.34E+00	1.63E+01	2.00E+01
Testes	1.45E+02	1.36E+03	1.63E+03	3.91E+03	5.74E+04	8.41E+04	4.77E+07	4.78E+07
Thyroid	4.44E-01	5.01E-02	2.00E-02	4.58E-02	4.87E-01	4.64E-01	7.65E+00	9.16E+00
Bladder	1.53E-02	2.29E-02	8.23E-04	1.11E-03	1.20E-02	1.21E-02	8.04E-01	8.68E-01
others	1.09E+02	1.20E+01	4.80E+00	1.10E+01	1.17E+02	1.12E+02	2.00E+03	2.36E+03
whl.body	5.10E+04	1.35E+05	8.75E+04	1.96E+05	1.92E+06	1.61E+06	6.23E+07	6.63E+07
tot.body	3.30E+04	8.43E+04	8.62E+04	1.95E+05	1.90E+06	1.58E+06	4.85E+07	5.24E+07
EDE	2.77E+05	7.08E+05	7.19E+05	1.62E+06	1.58E+07	1.31E+07	3.36E+08	3.68E+08
Pu-239								
Adrenals	4.35E-01	9.48E-02	6.42E-02	1.45E-01	1.47E+00	1.31E+00	6.39E+01	6.74E+01
Brain	4.14E-01	4.40E-02	1.59E-02	3.67E-02	4.08E-01	4.18E-01	3.84E+01	3.97E+01
GI: LLI	8.64E+03	7.08E+04	1.34E+03	3.63E+02	3.33E+03	2.56E+03	1.00E+04	9.70E+04
GI: SI	2.26E+03	1.09E+03	1.44E+01	1.48E+01	1.38E+02	1.07E+02	4.30E+02	4.06E+03
GI: ST	2.66E+03	9.15E+02	1.44E+01	1.59E+01	1.48E+02	1.14E+02	4.60E+02	4.33E+03
GI: ULI	1.26E+04	2.06E+04	1.90E+02	1.47E+02	1.37E+03	1.06E+03	4.14E+03	4.01E+04
Kidneys	4.23E-01	6.29E-02	2.47E-02	5.63E-02	5.95E-01	5.69E-01	2.95E+01	3.12E+01
Liver	3.40E+03	3.18E+04	3.83E+04	9.17E+04	1.35E+06	1.97E+06	9.52E+08	9.56E+08
Lungs	2.15E+06	5.43E+06	5.56E+06	1.25E+07	1.21E+08	9.94E+07	1.09E+09	1.34E+09
Muscle	4.86E-01	2.26E-01	1.76E-01	3.98E-01	3.90E+00	3.29E+00	7.08E+01	7.93E+01
Ovaries	1.36E+02	1.27E+03	1.53E+03	3.67E+03	5.40E+04	7.94E+04	5.88E+07	5.90E+07
Pancreas	4.34E-01	7.99E-02	4.31E-02	9.77E-02	9.97E-01	9.01E-01	3.57E+01	3.82E+01
Marrow	1.00E+03	9.38E+03	1.13E+04	2.71E+04	3.98E+05	5.84E+05	3.78E+08	3.79E+08
Skeleton	1.25E+04	1.17E+05	1.41E+05	3.38E+05	4.98E+06	7.30E+06	4.73E+09	4.74E+09
Spleen	4.35E-01	9.26E-02	5.82E-02	1.32E-01	1.32E+00	1.15E+00	1.98E+01	2.30E+01
Testes	1.36E+02	1.27E+03	1.53E+03	3.67E+03	5.40E+04	7.94E+04	5.88E+07	5.90E+07
Thyroid	4.19E-01	5.55E-02	2.75E-02	6.26E-02	6.48E-01	5.97E-01	1.29E+01	1.47E+01
Bladder	1.81E-02	4.01E-02	1.36E-03	1.75E-03	1.89E-02	1.90E-02	3.16E+00	3.26E+00
others	1.02E+02	1.06E+01	3.90E+00	8.93E+00	9.64E+01	9.43E+01	1.58E+03	1.90E+03
whl.body	4.79E+04	1.27E+05	8.21E+04	1.84E+05	1.80E+06	1.52E+06	7.31E+07	7.69E+07
tot.body	3.10E+04	7.91E+04	8.09E+04	1.83E+05	1.78E+06	1.50E+06	5.63E+07	6.00E+07
EDE	2.60E+05	6.64E+05	6.75E+05	1.52E+06	1.48E+07	1.24E+07	3.90E+08	4.20E+08

Pu-240								
Adrenals	4.22E-01	6.36E-02	3.46E-02	7.87E-02	8.09E-01	7.38E-01	2.47E+01	2.68E+01
Brain	4.14E-01	4.23E-02	1.41E-02	3.25E-02	3.56E-01	3.56E-01	9.20E+00	1.04E+01
GI: LLI	8.61E+03	7.05E+04	1.33E+03	3.61E+02	3.31E+03	2.55E+03	9.95E+03	9.66E+04
GI: SI	2.25E+03	1.09E+03	1.43E+01	1.48E+01	1.38E+02	1.06E+02	4.18E+02	4.03E+03
GI: ST	2.65E+03	9.11E+02	1.43E+01	1.58E+01	1.47E+02	1.13E+02	4.48E+02	4.30E+03
GI: ULI	1.26E+04	2.05E+04	1.89E+02	1.47E+02	1.37E+03	1.05E+03	4.11E+03	3.99E+04
Kidneys	4.18E-01	5.09E-02	1.85E-02	4.22E-02	4.53E-01	4.41E-01	1.53E+01	1.67E+01
Liver	3.40E+03	3.18E+04	3.83E+04	9.18E+04	1.35E+06	1.97E+06	9.51E+08	9.54E+08
Lungs	2.15E+06	5.44E+06	5.56E+06	1.26E+07	1.21E+08	9.95E+07	1.09E+09	1.34E+09
Muscle	4.19E-01	5.79E-02	2.36E-02	5.35E-02	5.60E-01	5.24E-01	1.08E+01	1.25E+01
Ovaries	1.36E+02	1.27E+03	1.53E+03	3.68E+03	5.41E+04	7.95E+04	5.87E+07	5.89E+07
Pancreas	4.23E-01	6.10E-02	2.93E-02	6.68E-02	6.92E-01	6.40E-01	2.00E+01	2.19E+01
Marrow	1.00E+03	9.39E+03	1.13E+04	2.71E+04	3.99E+05	5.85E+05	3.78E+08	3.79E+08
Skeleton	1.25E+04	1.17E+05	1.41E+05	3.39E+05	4.98E+06	7.31E+06	4.72E+09	4.73E+09
Spleen	4.22E-01	6.04E-02	2.95E-02	6.71E-02	6.90E-01	6.29E-01	1.02E+01	1.21E+01
Testes	1.36E+02	1.27E+03	1.53E+03	3.68E+03	5.41E+04	7.95E+04	5.87E+07	5.89E+07
Thyroid	4.16E-01	4.79E-02	1.98E-02	4.53E-02	4.80E-01	4.56E-01	8.11E+00	9.58E+00
Bladder	1.34E-02	2.29E-02	7.56E-04	9.48E-04	1.04E-02	1.05E-02	1.08E+00	1.14E+00
others	1.01E+02	9.99E+00	3.37E+00	7.74E+00	8.48E+01	8.45E+01	1.11E+03	1.40E+03
whl.body	4.80E+04	1.27E+05	8.22E+04	1.84E+05	1.81E+06	1.53E+06	7.30E+07	7.68E+07
tot.body	3.10E+04	7.92E+04	8.10E+04	1.83E+05	1.79E+06	1.50E+06	5.63E+07	5.99E+07
EDE	2.60E+05	6.65E+05	6.76E+05	1.53E+06	1.49E+07	1.24E+07	3.90E+08	4.20E+08

Pu-241								
Adrenals	4.20E-04	1.25E-03	1.80E-03	6.37E-03	2.43E-01	4.85E-01	4.09E+02	4.10E+02
Brain	3.19E-05	3.87E-05	5.97E-05	1.95E-04	8.09E-03	1.93E-02	1.10E+02	1.10E+02
GI: LLI	4.38E+01	3.59E+02	6.82E+00	1.87E+00	1.84E+01	1.59E+01	1.53E+02	5.99E+02
GI: SI	1.14E+01	5.54E+00	7.33E-02	7.68E-02	7.77E-01	6.91E-01	1.14E+02	1.33E+02
GI: ST	1.35E+01	4.64E+00	7.41E-02	8.47E-02	9.39E-01	9.50E-01	1.43E+02	1.63E+02
GI: ULI	6.38E+01	1.04E+02	9.67E-01	7.59E-01	7.58E+00	6.57E+00	1.89E+02	3.72E+02
Kidneys	2.62E-04	6.18E-04	5.17E-04	1.78E-03	6.83E-02	1.42E-01	2.44E+02	2.44E+02
Liver	1.80E-01	2.03E+00	4.77E+00	1.36E+01	8.27E+02	2.68E+03	2.22E+07	2.22E+07
Lungs	1.12E+02	3.66E+02	5.49E+02	1.91E+03	6.91E+04	1.32E+05	1.61E+07	1.63E+07
Muscle	2.42E-04	7.95E-04	8.00E-04	2.94E-03	1.16E-01	2.31E-01	1.33E+02	1.33E+02
Ovaries	7.91E-03	8.47E-02	1.88E-01	5.40E-01	3.32E+01	1.08E+02	1.48E+06	1.48E+06
Pancreas	4.39E-04	1.14E-03	1.43E-03	5.11E-03	1.98E-01	3.95E-01	3.30E+02	3.30E+02
Marrow	5.42E-02	6.09E-01	1.40E+00	4.01E+00	2.45E+02	7.94E+02	9.32E+06	9.32E+06
Skeleton	6.74E-01	7.61E+00	1.75E+01	5.01E+01	3.06E+03	9.93E+03	1.16E+08	1.16E+08
Spleen	3.65E-04	1.02E-03	1.28E-03	4.62E-03	1.76E-01	3.44E-01	1.14E+02	1.14E+02
Testes	7.23E-03	8.18E-02	1.88E-01	5.39E-01	3.32E+01	1.08E+02	1.48E+06	1.48E+06
Thyroid	1.48E-04	4.26E-04	6.53E-04	2.31E-03	8.61E-02	1.68E-01	8.38E+01	8.41E+01
Bladder	2.45E-04	1.10E-03	4.30E-05	5.38E-05	2.13E-03	5.09E-03	3.06E+01	3.06E+01
others	5.48E-03	1.59E-03	1.45E-03	5.50E-03	2.29E-01	4.76E-01	3.08E+02	3.09E+02
whl.body	2.51E+00	8.26E+00	8.15E+00	2.81E+01	1.03E+03	2.03E+03	1.61E+06	1.62E+06
tot.body	2.03E+00	6.50E+00	8.04E+00	2.79E+01	1.02E+03	1.99E+03	1.20E+06	1.21E+06
EDE	2.14E+01	7.28E+01	6.73E+01	2.33E+02	8.48E+03	1.65E+04	8.24E+06	8.27E+06

Pu-242									
Adrenals	4.09E-01	7.90E-02	5.21E-02	1.18E-01	1.21E+00	1.09E+00	6.40E+01	6.69E+01	
Brain	3.94E-01	4.14E-02	1.48E-02	3.41E-02	3.87E-01	4.09E-01	5.42E+01	5.55E+01	
GI: LLI	8.22E+03	6.74E+04	1.27E+03	3.45E+02	3.17E+03	2.44E+03	9.53E+03	9.23E+04	
GI: SI	2.15E+03	1.04E+03	1.37E+01	1.41E+01	1.32E+02	1.01E+02	4.08E+02	3.86E+03	
GI: ST	2.53E+03	8.70E+02	1.37E+01	1.51E+01	1.41E+02	1.09E+02	4.33E+02	4.12E+03	
GI: ULI	1.20E+04	1.96E+04	1.81E+02	1.40E+02	1.30E+03	1.00E+03	3.93E+03	3.81E+04	
Kidneys	3.97E-01	4.81E-02	1.76E-02	4.01E-02	4.35E-01	4.29E-01	2.18E+01	2.32E+01	
Liver	3.23E+03	3.02E+04	3.64E+04	8.71E+04	1.28E+06	1.87E+06	9.05E+08	9.08E+08	
Lungs	2.04E+06	5.16E+06	5.28E+06	1.19E+07	1.15E+08	9.44E+07	1.04E+09	1.27E+09	
Muscle	5.11E-01	3.38E-01	2.87E-01	6.47E-01	6.32E+00	5.28E+00	1.09E+02	1.22E+02	
Ovaries	1.29E+02	1.21E+03	1.46E+03	3.49E+03	5.13E+04	7.54E+04	5.59E+07	5.61E+07	
Pancreas	4.07E-01	5.85E-02	2.70E-02	6.14E-02	6.39E-01	5.96E-01	2.25E+01	2.42E+01	
Marrow	9.53E+02	8.91E+03	1.07E+04	2.57E+04	3.78E+05	5.55E+05	3.60E+08	3.61E+08	
Skeleton	1.19E+04	1.11E+05	1.34E+05	3.21E+05	4.73E+06	6.94E+06	4.49E+09	4.51E+09	
Spleen	4.13E-01	8.70E-02	5.85E-02	1.32E-01	1.32E+00	1.14E+00	1.60E+01	1.91E+01	
Testes	1.29E+02	1.21E+03	1.46E+03	3.49E+03	5.13E+04	7.54E+04	5.59E+07	5.61E+07	
Thyroid	3.95E-01	4.52E-02	1.84E-02	4.21E-02	4.47E-01	4.27E-01	7.94E+00	9.31E+00	
Bladder	1.38E-02	2.17E-02	7.56E-04	9.91E-04	1.08E-02	1.09E-02	1.00E+00	1.06E+00	
others	9.66E+01	1.05E+01	4.15E+00	9.48E+00	1.01E+02	9.79E+01	1.90E+03	2.22E+03	
whl.body	4.55E+04	1.20E+05	7.80E+04	1.75E+05	1.71E+06	1.45E+06	6.95E+07	7.31E+07	
tot.body	2.94E+04	7.51E+04	7.68E+04	1.73E+05	1.69E+06	1.42E+06	5.35E+07	5.70E+07	
EDE	2.47E+05	6.31E+05	6.41E+05	1.45E+06	1.41E+07	1.17E+07	3.71E+08	4.00E+08	

Am-241									
Adrenals	1.77E+01	3.06E+01	2.95E+01	6.34E+01	5.15E+02	4.25E+02	3.77E+04	3.88E+04	
Brain	8.71E+00	3.54E+00	3.42E+00	7.99E+00	9.41E+01	9.67E+01	1.12E+04	1.15E+04	
GI: LLI	7.62E+03	6.79E+04	2.78E+03	3.04E+03	1.11E+04	1.10E+03	6.53E+03	1.00E+05	
GI: SI	2.06E+03	1.21E+03	7.75E+01	1.35E+02	5.73E+02	1.62E+02	1.14E+04	1.56E+04	
GI: ST	2.43E+03	1.02E+03	8.84E+01	1.59E+02	6.70E+02	1.81E+02	1.17E+04	1.63E+04	
GI: ULI	1.12E+04	2.04E+04	7.72E+02	1.25E+03	4.66E+03	5.97E+02	1.58E+04	5.48E+04	
Kidneys	1.35E+01	1.66E+01	1.26E+01	2.82E+01	2.85E+02	2.73E+02	2.45E+04	2.51E+04	
Liver	6.59E+04	6.23E+05	7.61E+05	1.85E+06	2.52E+07	2.76E+07	2.39E+09	2.44E+09	
Lungs	2.15E+06	5.54E+06	5.25E+06	1.04E+07	4.05E+07	4.51E+06	6.17E+05	6.90E+07	
Muscle	1.40E+01	1.85E+01	1.25E+01	2.59E+01	1.74E+02	1.19E+02	1.12E+04	1.15E+04	
Ovaries	2.65E+03	2.50E+04	3.04E+04	7.42E+04	1.01E+06	1.11E+06	1.51E+08	1.53E+08	
Pancreas	1.85E+01	2.83E+01	2.44E+01	5.23E+01	4.25E+02	3.50E+02	3.05E+04	3.14E+04	
Marrow	1.95E+04	1.84E+05	2.25E+05	5.47E+05	7.47E+06	8.20E+06	9.63E+08	9.79E+08	
Skeleton	2.43E+05	2.30E+06	2.81E+06	6.84E+06	9.34E+07	1.02E+08	1.20E+10	1.22E+10	
Spleen	1.61E+01	2.03E+01	1.61E+01	3.27E+01	1.78E+02	8.90E+01	7.65E+03	8.01E+03	
Testes	2.64E+03	2.49E+04	3.04E+04	7.42E+04	1.01E+06	1.11E+06	1.51E+08	1.53E+08	
Thyroid	1.11E+01	9.10E+00	8.44E+00	1.74E+01	1.07E+02	6.42E+01	6.64E+03	6.86E+03	
Bladder	4.46E+00	2.06E+01	1.67E+00	2.99E+00	2.99E+01	2.88E+01	3.16E+03	3.25E+03	
others	1.98E+03	2.55E+02	1.18E+02	2.44E+02	1.27E+03	4.14E+02	2.71E+04	3.14E+04	
whl.body	5.09E+04	1.57E+05	1.16E+05	2.46E+05	1.89E+06	1.49E+06	1.45E+08	1.49E+08	
tot.body	3.53E+04	1.04E+05	1.04E+05	2.20E+05	1.55E+06	1.13E+06	1.03E+08	1.06E+08	
EDE	2.73E+05	8.05E+05	7.94E+05	1.64E+06	1.03E+07	6.53E+06	6.58E+08	6.78E+08	

A.3 INGESTION DOSE CONVERSION FACTORS, 50-YEAR COMMITMENT

*IDCFMAX Output of Dose Conversion Factors for:

*INGESTION MACCS Select File was: selpu50.dat

IDCFMAX INGESTION Calculation 09/08/93 09:17:48

22 organs (as for original IDCF code):

Adrenals	Brain	GI: LLI	GI: SI	GI: ST	GI: ULI	Kidneys	Liver
Lungs	Muscle	Ovaries	Pancreas	Marrow	Skeleton	Spleen	Testes
Thyroid	Bladder	others	whl.body	tot.body	EDE		

7 Number of Integration times, in days, as follows:

1	1 d
2	7 d
3	14 d
4	30 d
5	200 d
6	365 d
7	18250 d

6 Number of Nuclides Selected as follows:

Pu-238	Pu-239	Pu-240	Pu-241	Pu-242	Am-241	END		
DCF's				rem/ci				
	1 d	7 d	14 d	30 d	200 d	365 d	18250 d	TOTALS
Pu-238								
Adrenals	4.25E-03	1.29E-03	8.02E-06	1.38E-05	1.46E-04	1.40E-04	8.90E-03	1.47E-02
Brain	1.05E-03	1.66E-04	4.61E-06	1.05E-05	1.11E-04	1.07E-04	8.24E-03	9.69E-03
GI: LLI	5.07E+04	1.26E+05	4.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E+05
GI: SI	7.35E+03	2.55E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.38E+03
GI: ST	7.87E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.87E+03
GI: ULI	5.51E+04	1.79E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.31E+04
Kidneys	1.04E-02	4.15E-03	0.00E+00	0.00E+00	4.41E-05	4.23E-05	2.70E-03	1.74E-02
Liver	6.84E+00	8.50E+01	1.00E+02	2.28E+02	2.41E+03	2.31E+03	1.43E+05	1.48E+05
Lungs	1.79E-03	3.39E-04	5.86E-06	1.27E-05	1.34E-04	1.28E-04	8.08E-03	1.05E-02
Muscle	6.25E-02	5.06E-02	1.62E-04	0.00E+00	1.36E-04	1.31E-04	8.81E-03	1.22E-01
Ovaries	1.33E+00	4.97E+00	4.01E+00	9.14E+00	9.69E+01	9.36E+01	7.92E+03	8.13E+03
Pancreas	3.01E-02	3.10E-03	0.00E+00	0.00E+00	3.99E-05	3.83E-05	2.41E-03	3.57E-02
Marrow	2.05E+00	2.51E+01	2.95E+01	6.74E+01	7.13E+02	6.88E+02	5.28E+04	5.43E+04
Skeleton	2.52E+01	3.14E+02	3.69E+02	8.42E+02	8.92E+03	8.60E+03	6.60E+05	6.79E+05
Spleen	8.07E-03	3.16E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.01E-04	1.17E-02
Testes	2.76E-01	3.41E+00	4.00E+00	9.14E+00	9.69E+01	9.36E+01	7.92E+03	8.13E+03
Thyroid	1.06E-03	1.67E-04	0.00E+00	0.00E+00	5.03E-06	4.85E-06	3.70E-04	1.61E-03
Bladder	1.94E-02	3.43E-02	1.16E-04	0.00E+00	0.00E+00	0.00E+00	1.16E-04	5.39E-02
others	4.74E-01	2.54E-01	0.00E+00	0.00E+00	1.76E-03	1.69E-03	1.17E-01	8.49E-01
whl.body	7.37E+04	6.90E+04	2.08E+02	0.00E+00	0.00E+00	0.00E+00	8.29E+03	1.51E+05
tot.body	3.66E+02	3.45E+02	4.85E+00	8.77E+00	9.26E+01	8.90E+01	5.95E+03	6.85E+03
EDE	7.27E+03	8.65E+03	4.80E+01	4.93E+01	5.22E+02	5.03E+02	3.67E+04	5.37E+04
Pu-239								
Adrenals	1.06E-02	4.10E-03	0.00E+00	0.00E+00	1.13E-04	1.09E-04	8.23E-03	2.32E-02
Brain	9.94E-04	1.59E-04	2.48E-06	5.64E-06	5.98E-05	5.78E-05	5.30E-03	6.58E-03
GI: LLI	4.75E+04	1.18E+05	4.12E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E+05
GI: SI	6.88E+03	2.34E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.91E+03
GI: ST	7.37E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.37E+03
GI: ULI	5.16E+04	1.68E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.84E+04
Kidneys	2.36E-02	1.14E-02	0.00E+00	0.00E+00	5.21E-05	5.02E-05	3.80E-03	3.89E-02
Liver	6.43E+00	7.98E+01	9.38E+01	2.14E+02	2.27E+03	2.18E+03	1.59E+05	1.64E+05
Lungs	3.28E-03	9.99E-04	5.21E-06	7.87E-06	8.33E-05	8.03E-05	6.04E-03	1.05E-02
Muscle	3.98E-02	3.43E-02	1.07E-04	0.00E+00	0.00E+00	0.00E+00	5.63E-03	8.00E-02
Ovaries	8.14E-01	3.99E+00	3.76E+00	8.58E+00	9.11E+01	8.83E+01	8.99E+03	9.19E+03
Pancreas	3.25E-02	8.38E-03	0.00E+00	0.00E+00	5.85E-05	5.64E-05	4.24E-03	4.52E-02
Marrow	1.92E+00	2.36E+01	2.77E+01	6.33E+01	6.71E+02	6.49E+02	5.95E+04	6.10E+04
Skeleton	2.37E+01	2.94E+02	3.46E+02	7.91E+02	8.39E+03	8.12E+03	7.44E+05	7.62E+05
Spleen	1.73E-02	8.56E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.08E-03	2.70E-02
Testes	2.64E-01	3.21E+00	3.75E+00	8.58E+00	9.11E+01	8.83E+01	8.99E+03	9.19E+03
Thyroid	1.09E-03	2.13E-04	0.00E+00	0.00E+00	1.04E-05	1.01E-05	9.08E-04	2.24E-03
Bladder	3.78E-02	5.99E-02	1.99E-04	0.00E+00	0.00E+00	0.00E+00	4.77E-04	9.84E-02
others	3.49E-01	1.42E-01	0.00E+00	0.00E+00	7.82E-04	7.54E-04	6.20E-02	5.55E-01
whl.body	6.92E+04	6.47E+04	1.95E+02	0.00E+00	0.00E+00	0.00E+00	9.28E+03	1.44E+05
tot.body	3.43E+02	3.23E+02	4.54E+00	8.23E+00	8.71E+01	8.40E+01	6.64E+03	7.49E+03
EDE	6.80E+03	8.10E+03	4.50E+01	4.63E+01	4.91E+02	4.74E+02	4.12E+04	5.72E+04

Pu-240									
Adrenals	4.57E-03	1.40E-03	0.00E+00	0.00E+00	3.66E-05	3.53E-05	2.68E-03	8.72E-03	
Brain	9.82E-04	1.52E-04	0.00E+00	0.00E+00	8.33E-06	8.06E-06	7.37E-04	1.89E-03	
GI: LLI	4.73E+04	1.17E+05	4.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E+05	
GI: SI	6.85E+03	2.28E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.88E+03	
GI: ST	7.34E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.34E+03	
GI: ULI	5.14E+04	1.67E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.81E+04	
Kidneys	1.15E-02	4.59E-03	0.00E+00	0.00E+00	2.27E-05	2.19E-05	1.65E-03	1.78E-02	
Liver	6.42E+00	7.99E+01	9.39E+01	2.15E+02	2.27E+03	2.19E+03	1.59E+05	1.64E+05	
Lungs	1.77E-03	3.36E-04	0.00E+00	0.00E+00	2.00E-05	1.92E-05	1.47E-03	3.63E-03	
Muscle	9.99E-03	9.15E-03	2.75E-05	0.00E+00	0.00E+00	0.00E+00	7.27E-04	1.99E-02	
Ovaries	3.50E-01	3.31E+00	3.76E+00	8.59E+00	9.12E+01	8.84E+01	8.99E+03	9.18E+03	
Pancreas	1.34E-02	3.49E-03	0.00E+00	0.00E+00	2.89E-05	2.78E-05	2.08E-03	1.90E-02	
Marrow	1.91E+00	2.36E+01	2.77E+01	6.34E+01	6.72E+02	6.50E+02	5.95E+04	6.09E+04	
Skeleton	2.37E+01	2.95E+02	3.47E+02	7.92E+02	8.40E+03	8.13E+03	7.44E+05	7.62E+05	
Spleen	8.82E-03	3.52E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.28E-04	1.28E-02	
Testes	2.60E-01	3.20E+00	3.76E+00	8.59E+00	9.12E+01	8.84E+01	8.99E+03	9.18E+03	
Thyroid	9.93E-04	1.56E-04	0.00E+00	0.00E+00	4.43E-06	4.29E-06	3.89E-04	1.55E-03	
Bladder	2.02E-02	3.43E-02	1.15E-04	0.00E+00	0.00E+00	0.00E+00	1.54E-04	5.48E-02	
others	2.53E-01	4.62E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.49E-03	3.00E-01	
whl.body	6.93E+04	6.48E+04	1.96E+02	0.00E+00	0.00E+00	0.00E+00	9.27E+03	1.44E+05	
tot.body	3.41E+02	3.22E+02	4.54E+00	8.24E+00	8.72E+01	8.41E+01	6.64E+03	7.48E+03	
EDE	6.77E+03	8.06E+03	4.49E+01	4.64E+01	4.92E+02	4.75E+02	4.12E+04	5.71E+04	

Pu-241									
Adrenals	2.42E-04	1.08E-04	4.32E-07	4.56E-07	1.92E-05	4.32E-05	4.97E-02	5.01E-02	
Brain	1.48E-07	6.25E-08	2.81E-08	1.04E-07	4.46E-06	1.01E-05	1.46E-02	1.46E-02	
GI: LLI	2.40E+02	5.97E+02	2.10E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.40E+02	
GI: SI	3.48E+01	1.18E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.50E+01	
GI: ST	3.73E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.73E+01	
GI: ULI	2.61E+02	8.51E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.46E+02	
Kidneys	5.40E-04	3.06E-04	1.07E-06	0.00E+00	1.26E-05	2.83E-05	3.23E-02	3.31E-02	
Liver	7.18E-04	5.64E-03	9.29E-03	3.27E-02	1.32E+00	2.93E+00	3.16E+03	3.16E+03	
Lungs	5.18E-05	1.93E-05	1.18E-07	2.43E-07	1.04E-05	2.33E-05	2.72E-02	2.73E-02	
Muscle	3.60E-04	4.23E-04	2.12E-06	0.00E+00	5.20E-06	1.17E-05	1.46E-02	1.54E-02	
Ovaries	3.01E-03	4.57E-03	3.96E-04	1.31E-03	5.30E-02	1.19E-01	1.93E+02	1.94E+02	
Pancreas	5.49E-04	2.39E-04	9.18E-07	0.00E+00	1.59E-05	3.56E-05	4.02E-02	4.10E-02	
Marrow	6.23E-04	2.30E-03	2.77E-03	9.72E-03	3.91E-01	8.72E-01	1.25E+03	1.25E+03	
Skeleton	1.81E-03	2.12E-02	3.46E-02	1.21E-01	4.88E+00	1.09E+01	1.57E+04	1.57E+04	
Spleen	3.91E-04	2.46E-04	1.03E-06	0.00E+00	3.65E-06	8.15E-06	1.00E-02	1.07E-02	
Testes	1.96E-04	6.38E-04	3.74E-04	1.31E-03	5.30E-02	1.19E-01	1.93E+02	1.94E+02	
Thyroid	1.55E-06	7.44E-07	2.05E-08	6.63E-08	2.74E-06	6.15E-06	8.65E-03	8.66E-03	
Bladder	8.83E-04	1.60E-03	8.84E-06	0.00E+00	0.00E+00	3.02E-06	4.13E-03	6.63E-03	
others	4.24E-04	4.67E-04	2.42E-06	0.00E+00	1.22E-05	2.78E-05	3.55E-02	3.64E-02	
whl.body	3.62E+00	3.86E+00	1.80E-02	0.00E+00	6.79E-02	1.51E-01	1.90E+02	1.98E+02	
tot.body	1.73E+00	1.62E+00	5.17E-03	0.00E+00	5.07E-02	1.13E-01	1.35E+02	1.39E+02	
EDE	3.44E+01	4.10E+01	1.28E-01	0.00E+00	2.86E-01	6.37E-01	8.58E+02	9.34E+02	

Pu-242								
Adrenals	4.17E-03	1.29E-03	6.97E-06	1.13E-05	1.20E-04	1.15E-04	8.66E-03	1.44E-02
Brain	9.35E-04	1.47E-04	3.65E-06	8.34E-06	8.84E-05	8.56E-05	7.85E-03	9.12E-03
GI: LLI	4.52E+04	1.12E+05	3.92E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E+05
GI: SI	6.55E+03	2.26E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.57E+03
GI: ST	7.01E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.01E+03
GI: ULI	4.91E+04	1.60E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.51E+04
Kidneys	1.02E-02	4.11E-03	0.00E+00	0.00E+00	3.83E-05	3.69E-05	2.78E-03	1.72E-02
Liver	6.10E+00	7.58E+01	8.91E+01	2.04E+02	2.15E+03	2.07E+03	1.51E+05	1.55E+05
Lungs	1.66E-03	3.21E-04	4.77E-06	1.02E-05	1.08E-04	1.04E-04	7.71E-03	9.92E-03
Muscle	5.04E-02	4.10E-02	1.31E-04	0.00E+00	1.08E-04	1.04E-04	8.31E-03	1.00E-01
Ovaries	1.08E+00	4.27E+00	3.57E+00	8.15E+00	8.65E+01	8.39E+01	8.54E+03	8.73E+03
Pancreas	2.58E-02	3.13E-03	0.00E+00	0.00E+00	3.61E-05	3.47E-05	2.58E-03	3.16E-02
Marrow	1.82E+00	2.24E+01	2.63E+01	6.01E+01	6.37E+02	6.17E+02	5.66E+04	5.80E+04
Skeleton	2.25E+01	2.80E+02	3.29E+02	7.51E+02	7.97E+03	7.71E+03	7.07E+05	7.24E+05
Spleen	7.85E-03	3.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.56E-04	1.15E-02
Testes	2.46E-01	3.04E+00	3.56E+00	8.15E+00	8.65E+01	8.39E+01	8.54E+03	8.73E+03
Thyroid	9.45E-04	1.49E-04	0.00E+00	0.00E+00	4.73E-06	4.57E-06	4.16E-04	1.52E-03
Bladder	1.87E-02	3.25E-02	1.09E-04	0.00E+00	0.00E+00	0.00E+00	1.41E-04	5.14E-02
others	4.00E-01	2.04E-01	0.00E+00	0.00E+00	1.38E-03	1.33E-03	1.10E-01	7.17E-01
whl.body	6.57E+04	6.14E+04	1.86E+02	0.00E+00	0.00E+00	0.00E+00	8.81E+03	1.36E+05
tot.body	3.26E+02	3.08E+02	4.32E+00	7.81E+00	8.27E+01	7.98E+01	6.31E+03	7.12E+03
EDE	6.47E+03	7.70E+03	4.28E+01	4.40E+01	4.66E+02	4.51E+02	3.92E+04	5.44E+04

Am-241								
Adrenals	4.74E+00	1.86E+00	7.74E-02	1.69E-01	1.79E+00	1.72E+00	1.27E+02	1.37E+02
Brain	5.64E-02	2.34E-02	1.72E-02	3.94E-02	4.17E-01	4.03E-01	3.56E+01	3.66E+01
GI: LLI	5.18E+04	1.28E+05	4.49E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E+05
GI: SI	7.57E+03	9.20E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.79E+01	7.70E+03
GI: ST	8.04E+03	1.12E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.94E+01	8.09E+03
GI: ULI	5.62E+04	1.83E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.46E+04
Kidneys	1.22E+01	5.31E+00	5.89E-02	1.11E-01	1.17E+00	1.13E+00	8.24E+01	1.02E+02
Liver	3.50E+02	4.25E+03	4.99E+03	1.14E+04	1.21E+05	1.16E+05	8.16E+06	8.42E+06
Lungs	1.06E+00	3.22E-01	4.04E-02	9.12E-02	9.65E-01	9.29E-01	6.91E+01	7.25E+01
Muscle	9.04E+00	8.95E+00	4.68E-02	4.56E-02	4.83E-01	4.66E-01	3.67E+01	5.57E+01
Ovaries	9.95E+01	2.78E+02	2.00E+02	4.57E+02	4.85E+03	4.69E+03	4.60E+05	4.71E+05
Pancreas	1.39E+01	4.57E+00	7.02E-02	1.39E-01	1.47E+00	1.42E+00	1.03E+02	1.24E+02
Marrow	1.12E+02	1.27E+03	1.47E+03	3.37E+03	3.57E+04	3.45E+04	3.05E+06	3.13E+06
Skeleton	1.27E+03	1.57E+04	1.84E+04	4.21E+04	4.46E+05	4.31E+05	3.81E+07	3.91E+07
Spleen	8.84E+00	4.25E+00	2.51E-02	3.17E-02	3.35E-01	3.23E-01	2.52E+01	3.90E+01
Testes	1.79E+01	1.78E+02	2.00E+02	4.56E+02	4.85E+03	4.69E+03	4.60E+05	4.71E+05
Thyroid	7.44E-02	2.47E-02	1.05E-02	2.39E-02	2.53E-01	2.44E-01	2.12E+01	2.18E+01
Bladder	2.15E+01	3.49E+01	1.21E-01	0.00E+00	1.24E-01	1.19E-01	1.01E+01	6.69E+01
others	2.41E+01	1.27E+01	7.99E-02	1.10E-01	1.16E+00	1.12E+00	8.88E+01	1.28E+02
whl.body	7.36E+04	6.90E+04	4.60E+02	5.87E+02	6.21E+03	5.99E+03	4.76E+05	6.32E+05
tot.body	4.15E+02	5.29E+02	1.93E+02	4.38E+02	4.63E+03	4.47E+03	3.41E+05	3.52E+05
EDE	7.52E+03	9.75E+03	1.11E+03	2.46E+03	2.61E+04	2.52E+04	2.11E+06	2.19E+06

A.4 INGESTION DOSE CONVERSION FACTORS, 70-YEAR COMMITMENT

*IDCFMAX Output of Dose Conversion Factors for:

*INGESTION MACCS Select File was: selpu70.dat

IDCFMAX INGESTION Calculation 09/08/93 09:21:27

22 organs (as for original IDCF code):

Adrenals Brain GI: LLI GI: SI GI: ST GI: ULI Kidneys Liver
Lungs Muscle Ovaries Pancreas Marrow Skeleton Spleen Testes
Thyroid Bladder others whl.body tot.body EDE

7 Number of Integration times, in days, as follows:

1 1 d
2 7 d
3 14 d
4 30 d
5 200 d
6 365 d
7 25550 d

6 Number of Nuclides Selected as follows:

Pu-238 Pu-239 Pu-240 Pu-241 Pu-242 Am-241 END

	DCF's				rem/ci				TOTALS
	1 d	7 d	14 d	30 d	200 d	365 d	25550 d		
Pu-238									
Adrenals	4.25E-03	1.29E-03	8.02E-06	1.38E-05	1.46E-04	1.40E-04	1.04E-02	1.63E-02	
Brain	1.05E-03	1.66E-04	4.61E-06	1.05E-05	1.11E-04	1.07E-04	1.02E-02	1.17E-02	
GI: LLI	5.07E+04	1.26E+05	4.40E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.77E+05	
GI: SI	7.35E+03	2.55E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.38E+03	
GI: ST	7.87E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.87E+03	
GI: ULI	5.51E+04	1.79E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.31E+04	
Kidneys	1.04E-02	4.15E-03	0.00E+00	0.00E+00	4.41E-05	4.23E-05	3.17E-03	1.79E-02	
Liver	6.84E+00	8.50E+01	1.00E+02	2.28E+02	2.41E+03	2.31E+03	1.66E+05	1.71E+05	
Lungs	1.79E-03	3.39E-04	5.86E-06	1.27E-05	1.34E-04	1.28E-04	9.45E-03	1.19E-02	
Muscle	6.25E-02	5.06E-02	1.62E-04	0.00E+00	1.36E-04	1.31E-04	1.05E-02	1.24E-01	
Ovaries	1.33E+00	4.97E+00	4.01E+00	9.14E+00	9.69E+01	9.36E+01	1.02E+04	1.04E+04	
Pancreas	3.01E-02	3.10E-03	0.00E+00	0.00E+00	3.99E-05	3.83E-05	2.82E-03	3.61E-02	
Marrow	2.05E+00	2.51E+01	2.95E+01	6.74E+01	7.13E+02	6.88E+02	6.55E+04	6.70E+04	
Skeleton	2.52E+01	3.14E+02	3.69E+02	8.42E+02	8.92E+03	8.60E+03	8.19E+05	8.38E+05	
Spleen	8.07E-03	3.16E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.86E-04	1.17E-02	
Testes	2.76E-01	3.41E+00	4.00E+00	9.14E+00	9.69E+01	9.36E+01	1.02E+04	1.04E+04	
Thyroid	1.06E-03	1.67E-04	0.00E+00	0.00E+00	5.03E-06	4.85E-06	4.58E-04	1.70E-03	
Bladder	1.94E-02	3.43E-02	1.16E-04	0.00E+00	0.00E+00	0.00E+00	1.43E-04	5.39E-02	
others	4.74E-01	2.54E-01	0.00E+00	0.00E+00	1.76E-03	1.69E-03	1.41E-01	8.74E-01	
whl.body	7.37E+04	6.90E+04	2.08E+02	0.00E+00	0.00E+00	0.00E+00	9.99E+03	1.53E+05	
tot.body	3.66E+02	3.45E+02	4.85E+00	8.77E+00	9.26E+01	8.90E+01	7.09E+03	8.00E+03	
EDE	7.27E+03	8.65E+03	4.80E+01	4.93E+01	5.22E+02	5.03E+02	4.49E+04	6.20E+04	
Pu-239									
Adrenals	1.06E-02	4.10E-03	0.00E+00	0.00E+00	1.13E-04	1.09E-04	1.02E-02	2.51E-02	
Brain	9.94E-04	1.59E-04	2.48E-06	5.64E-06	5.98E-05	5.78E-05	7.00E-03	8.27E-03	
GI: LLI	4.75E+04	1.18E+05	4.12E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.66E+05	
GI: SI	6.88E+03	2.34E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.91E+03	
GI: ST	7.37E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.37E+03	
GI: ULI	5.16E+04	1.68E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.84E+04	
Kidneys	2.36E-02	1.14E-02	0.00E+00	0.00E+00	5.21E-05	5.02E-05	4.71E-03	3.99E-02	
Liver	6.43E+00	7.98E+01	9.38E+01	2.14E+02	2.27E+03	2.18E+03	1.93E+05	1.98E+05	
Lungs	3.28E-03	9.99E-04	5.21E-06	7.87E-06	8.33E-05	8.03E-05	7.46E-03	1.19E-02	
Muscle	3.98E-02	3.43E-02	1.07E-04	0.00E+00	0.00E+00	0.00E+00	7.12E-03	8.15E-02	
Ovaries	8.14E-01	3.99E+00	3.76E+00	8.58E+00	9.11E+01	8.83E+01	1.23E+04	1.25E+04	
Pancreas	3.25E-02	8.38E-03	0.00E+00	0.00E+00	5.85E-05	5.64E-05	5.23E-03	4.62E-02	
Marrow	1.92E+00	2.36E+01	2.77E+01	6.33E+01	6.71E+02	6.49E+02	7.86E+04	8.00E+04	
Skeleton	2.37E+01	2.94E+02	3.46E+02	7.91E+02	8.39E+03	8.12E+03	9.82E+05	1.00E+06	
Spleen	1.73E-02	8.56E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.37E-03	2.73E-02	
Testes	2.64E-01	3.21E+00	3.75E+00	8.58E+00	9.11E+01	8.83E+01	1.23E+04	1.25E+04	
Thyroid	1.09E-03	2.13E-04	0.00E+00	0.00E+00	1.04E-05	1.01E-05	1.19E-03	2.52E-03	
Bladder	3.78E-02	5.99E-02	1.99E-04	0.00E+00	0.00E+00	0.00E+00	6.20E-04	9.85E-02	
others	3.49E-01	1.42E-01	0.00E+00	0.00E+00	7.82E-04	7.54E-04	7.91E-02	5.72E-01	
whl.body	6.92E+04	6.47E+04	1.95E+02	0.00E+00	0.00E+00	0.00E+00	1.18E+04	1.46E+05	
tot.body	3.43E+02	3.23E+02	4.54E+00	8.23E+00	8.71E+01	8.40E+01	8.35E+03	9.20E+03	
EDE	6.80E+03	8.10E+03	4.50E+01	4.63E+01	4.91E+02	4.74E+02	5.36E+04	6.95E+04	

Pu-240								
Adrenals	4.57E-03	1.40E-03	0.00E+00	0.00E+00	3.66E-05	3.53E-05	3.32E-03	9.36E-03
Brain	9.82E-04	1.52E-04	0.00E+00	0.00E+00	8.33E-06	8.06E-06	9.72E-04	2.12E-03
GI: LLI	4.73E+04	1.17E+05	4.10E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.65E+05
GI: SI	6.85E+03	2.28E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.88E+03
GI: ST	7.34E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.34E+03
GI: ULI	5.14E+04	1.67E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.81E+04
Kidneys	1.15E-02	4.59E-03	0.00E+00	0.00E+00	2.27E-05	2.19E-05	2.04E-03	1.82E-02
Liver	6.42E+00	7.99E+01	9.39E+01	2.15E+02	2.27E+03	2.19E+03	1.93E+05	1.98E+05
Lungs	1.77E-03	3.36E-04	0.00E+00	0.00E+00	2.00E-05	1.92E-05	1.83E-03	3.98E-03
Muscle	9.99E-03	9.15E-03	2.75E-05	0.00E+00	0.00E+00	0.00E+00	9.24E-04	2.01E-02
Ovaries	3.50E-01	3.31E+00	3.76E+00	8.59E+00	9.12E+01	8.84E+01	1.23E+04	1.25E+04
Pancreas	1.34E-02	3.49E-03	0.00E+00	0.00E+00	2.89E-05	2.78E-05	2.56E-03	1.95E-02
Marrow	1.91E+00	2.36E+01	2.77E+01	6.34E+01	6.72E+02	6.50E+02	7.85E+04	7.99E+04
Skeleton	2.37E+01	2.95E+02	3.47E+02	7.92E+02	8.40E+03	8.13E+03	9.81E+05	9.99E+05
Spleen	8.82E-03	3.52E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.44E-04	1.29E-02
Testes	2.60E-01	3.20E+00	3.76E+00	8.59E+00	9.12E+01	8.84E+01	1.23E+04	1.25E+04
Thyroid	9.93E-04	1.56E-04	0.00E+00	0.00E+00	4.43E-06	4.29E-06	5.11E-04	1.67E-03
Bladder	2.02E-02	3.43E-02	1.15E-04	0.00E+00	0.00E+00	0.00E+00	2.02E-04	5.48E-02
others	2.53E-01	4.62E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.89E-03	3.01E-01
whl.body	6.93E+04	6.48E+04	1.96E+02	0.00E+00	0.00E+00	0.00E+00	1.18E+04	1.46E+05
tot.body	3.41E+02	3.22E+02	4.54E+00	8.24E+00	8.72E+01	8.41E+01	8.34E+03	9.19E+03
EDE	6.77E+03	8.06E+03	4.49E+01	4.64E+01	4.92E+02	4.75E+02	5.35E+04	6.94E+04

Pu-241								
Adrenals	2.42E-04	1.08E-04	4.32E-07	4.56E-07	1.92E-05	4.32E-05	6.82E-02	6.86E-02
Brain	1.48E-07	6.25E-08	2.81E-08	1.04E-07	4.46E-06	1.01E-05	2.15E-02	2.16E-02
GI: LLI	2.40E+02	5.97E+02	2.10E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	8.40E+02
GI: SI	3.48E+01	1.18E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.50E+01
GI: ST	3.73E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.73E+01
GI: ULI	2.61E+02	8.51E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.46E+02
Kidneys	5.40E-04	3.06E-04	1.07E-06	0.00E+00	1.26E-05	2.83E-05	4.41E-02	4.50E-02
Liver	7.18E-04	5.64E-03	9.29E-03	3.27E-02	1.32E+00	2.93E+00	4.24E+03	4.24E+03
Lungs	5.18E-05	1.93E-05	1.18E-07	2.43E-07	1.04E-05	2.33E-05	3.75E-02	3.76E-02
Muscle	3.60E-04	4.23E-04	2.12E-06	0.00E+00	5.20E-06	1.17E-05	2.07E-02	2.15E-02
Ovaries	3.01E-03	4.57E-03	3.96E-04	1.31E-03	5.30E-02	1.19E-01	2.98E+02	2.98E+02
Pancreas	5.49E-04	2.39E-04	9.18E-07	0.00E+00	1.59E-05	3.56E-05	5.47E-02	5.56E-02
Marrow	6.23E-04	2.30E-03	2.77E-03	9.72E-03	3.91E-01	8.72E-01	1.85E+03	1.85E+03
Skeleton	1.81E-03	2.12E-02	3.46E-02	1.21E-01	4.88E+00	1.09E+01	2.31E+04	2.31E+04
Spleen	3.91E-04	2.46E-04	1.03E-06	0.00E+00	3.65E-06	8.15E-06	1.41E-02	1.48E-02
Testes	1.96E-04	6.38E-04	3.74E-04	1.31E-03	5.30E-02	1.19E-01	2.98E+02	2.98E+02
Thyroid	1.55E-06	7.44E-07	2.05E-08	6.63E-08	2.74E-06	6.15E-06	1.27E-02	1.27E-02
Bladder	8.83E-04	1.60E-03	8.84E-06	0.00E+00	0.00E+00	3.02E-06	6.00E-03	8.50E-03
others	4.24E-04	4.67E-04	2.42E-06	0.00E+00	1.22E-05	2.78E-05	5.02E-02	5.12E-02
whl.body	3.62E+00	3.86E+00	1.80E-02	0.00E+00	6.79E-02	1.51E-01	2.70E+02	2.78E+02
tot.body	1.73E+00	1.62E+00	5.17E-03	0.00E+00	5.07E-02	1.13E-01	1.88E+02	1.92E+02
EDE	3.44E+01	4.10E+01	1.28E-01	0.00E+00	2.86E-01	6.37E-01	1.24E+03	1.32E+03

Pu-242								
Adrenals	4.17E-03	1.29E-03	6.97E-06	1.13E-05	1.20E-04	1.15E-04	1.07E-02	1.64E-02
Brain	9.35E-04	1.47E-04	3.65E-06	8.34E-06	8.84E-05	8.56E-05	1.04E-02	1.16E-02
GI: LLI	4.52E+04	1.12E+05	3.92E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.58E+05
GI: SI	6.55E+03	2.26E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.57E+03
GI: ST	7.01E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.01E+03
GI: ULI	4.91E+04	1.60E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.51E+04
Kidneys	1.02E-02	4.11E-03	0.00E+00	0.00E+00	3.83E-05	3.69E-05	3.43E-03	1.78E-02
Liver	6.10E+00	7.58E+01	8.91E+01	2.04E+02	2.15E+03	2.07E+03	1.84E+05	1.88E+05
Lungs	1.66E-03	3.21E-04	4.77E-06	1.02E-05	1.08E-04	1.04E-04	9.47E-03	1.17E-02
Muscle	5.04E-02	4.10E-02	1.31E-04	0.00E+00	1.08E-04	1.04E-04	1.05E-02	1.02E-01
Ovaries	1.08E+00	4.27E+00	3.57E+00	8.15E+00	8.65E+01	8.39E+01	1.17E+04	1.19E+04
Pancreas	2.58E-02	3.13E-03	0.00E+00	0.00E+00	3.61E-05	3.47E-05	3.18E-03	3.21E-02
Marrow	1.82E+00	2.24E+01	2.63E+01	6.01E+01	6.37E+02	6.17E+02	7.47E+04	7.61E+04
Skeleton	2.25E+01	2.80E+02	3.29E+02	7.51E+02	7.97E+03	7.71E+03	9.34E+05	9.51E+05
Spleen	7.85E-03	3.17E-03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.84E-04	1.16E-02
Testes	2.46E-01	3.04E+00	3.56E+00	8.15E+00	8.65E+01	8.39E+01	1.17E+04	1.19E+04
Thyroid	9.45E-04	1.49E-04	0.00E+00	0.00E+00	4.73E-06	4.57E-06	5.48E-04	1.65E-03
Bladder	1.87E-02	3.25E-02	1.09E-04	0.00E+00	0.00E+00	0.00E+00	1.84E-04	5.15E-02
others	4.00E-01	2.04E-01	0.00E+00	0.00E+00	1.38E-03	1.33E-03	1.40E-01	7.47E-01
whl.body	6.57E+04	6.14E+04	1.86E+02	0.00E+00	0.00E+00	0.00E+00	1.12E+04	1.39E+05
tot.body	3.26E+02	3.08E+02	4.32E+00	7.81E+00	8.27E+01	7.98E+01	7.94E+03	8.75E+03
EDE	6.47E+03	7.70E+03	4.28E+01	4.40E+01	4.66E+02	4.51E+02	5.09E+04	6.61E+04

Am-241								
Adrenals	4.74E+00	1.86E+00	7.74E-02	1.69E-01	1.79E+00	1.72E+00	1.56E+02	1.66E+02
Brain	5.64E-02	2.34E-02	1.72E-02	3.94E-02	4.17E-01	4.03E-01	4.64E+01	4.74E+01
GI: LLI	5.18E+04	1.28E+05	4.49E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.81E+05
GI: SI	7.57E+03	9.20E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.71E+01	7.71E+03
GI: ST	8.04E+03	1.12E+01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.84E+01	8.10E+03
GI: ULI	5.62E+04	1.83E+04	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	7.46E+04
Kidneys	1.22E+01	5.31E+00	5.89E-02	1.11E-01	1.17E+00	1.13E+00	1.01E+02	1.21E+02
Liver	3.50E+02	4.25E+03	4.99E+03	1.14E+04	1.21E+05	1.16E+05	9.84E+06	1.01E+07
Lungs	1.06E+00	3.22E-01	4.04E-02	9.12E-02	9.65E-01	9.29E-01	8.51E+01	8.86E+01
Muscle	9.04E+00	8.95E+00	4.68E-02	4.56E-02	4.83E-01	4.66E-01	4.61E+01	6.51E+01
Ovaries	9.95E+01	2.78E+02	2.00E+02	4.57E+02	4.85E+03	4.69E+03	6.23E+05	6.33E+05
Pancreas	1.39E+01	4.57E+00	7.02E-02	1.39E-01	1.47E+00	1.42E+00	1.26E+02	1.47E+02
Marrow	1.12E+02	1.27E+03	1.47E+03	3.37E+03	3.57E+04	3.45E+04	3.97E+06	4.05E+06
Skeleton	1.27E+03	1.57E+04	1.84E+04	4.21E+04	4.46E+05	4.31E+05	4.97E+07	5.06E+07
Spleen	8.84E+00	4.25E+00	2.51E-02	3.17E-02	3.35E-01	3.23E-01	3.16E+01	4.54E+01
Testes	1.79E+01	1.78E+02	2.00E+02	4.56E+02	4.85E+03	4.69E+03	6.23E+05	6.33E+05
Thyroid	7.44E-02	2.47E-02	1.05E-02	2.39E-02	2.53E-01	2.44E-01	2.74E+01	2.80E+01
Bladder	2.15E+01	3.49E+01	1.21E-01	0.00E+00	1.24E-01	1.19E-01	1.31E+01	6.98E+01
others	2.41E+01	1.27E+01	7.99E-02	1.10E-01	1.16E+00	1.12E+00	1.12E+02	1.51E+02
whl.body	7.36E+04	6.90E+04	4.60E+02	5.87E+02	6.21E+03	5.99E+03	6.00E+05	7.56E+05
tot.body	4.15E+02	5.29E+02	1.93E+02	4.38E+02	4.63E+03	4.47E+03	4.24E+05	4.35E+05
EDE	7.52E+03	9.75E+03	1.11E+03	2.46E+03	2.61E+04	2.52E+04	2.71E+06	2.79E+06

APPENDIX B

METEOROLOGICAL STATISTICS FOR ROCKY FLATS PLANT FOR 1992

1. Bin Wind Rose
2. Complementary Cumulative Distribution Function
for χ/Q (s/m^3) at 1900 meters

(both based on EPA method of determining stability class)

B.1 BIN WIND ROSE FOR 1992, ROCKY FLATS PLANT

Stability classes based on EPA method

METEOROLOGICAL DATA FILE CONTAINS 295 HOURS OF OBSERVED RAIN DATA.
 ACCUMULATED RAIN MEASUREMENTS TOTALED 13.90 INCHES FOR THE YEAR.
 CONSTANT LID HEIGHTS (M) FOR 4 SEASONS = 1482 3070 3458 2161
 NON-ZERO WINDSPEEDS LESS THAN 0.5 M/S ARE SET TO 0.5 M/S

*** METEOROLOGICAL BIN SUMMARY ***

BIN PRIORITIES

RI XX - RAIN INTENSITY I WITHIN THE INTERVAL ENDING AT XX		INTERVAL ENDPOINTS ARE IN KILOMETERS FROM THE ACCIDENT SITE, THE 4 INTERVAL ENDPOINTS ARE																3	16	32	80
		RAIN INTENSITIES ARE IN MILLIMETERS OF RAIN PER HOUR, THE 2 INTENSITY BREAKPOINTS ARE																0.5	1.0		
1 B	3	0.042	0.020	0.019	0.017	0.015	0.019	0.016	0.032	0.046	0.086	0.088	0.104	0.118	0.186	0.129	0.064	1017		11.6096	
2 B	4	0.015	0.027	0.006	0.012	0.027	0.018	0.045	0.027	0.045	0.130	0.115	0.100	0.048	0.154	0.154	0.076	331		3.7785	
3 D	1	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1		0.0114	
4 D	2	0.061	0.061	0.101	0.066	0.127	0.066	0.083	0.096	0.061	0.061	0.031	0.035	0.013	0.035	0.057	0.044	228		2.6027	
5 D	3	0.071	0.068	0.067	0.065	0.118	0.092	0.095	0.079	0.096	0.032	0.027	0.021	0.016	0.026	0.065	0.062	812		9.2694	
6 D	4	0.077	0.059	0.076	0.077	0.085	0.091	0.089	0.101	0.087	0.055	0.031	0.019	0.012	0.024	0.041	0.076	1534		17.5114	
7 D	5	0.031	0.021	0.057	0.100	0.110	0.243	0.137	0.083	0.082	0.046	0.017	0.005	0.004	0.000	0.024	0.039	839		9.5776	
8 D	6	0.004	0.001	0.007	0.049	0.223	0.471	0.143	0.030	0.029	0.021	0.014	0.000	0.000	0.000	0.000	0.006	698		7.9680	
9 E	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	1		0.0114	
10 E	2	0.032	0.059	0.074	0.106	0.138	0.149	0.101	0.101	0.053	0.048	0.037	0.021	0.016	0.011	0.021	0.032	188		2.1461	
11 E	3	0.066	0.084	0.073	0.112	0.138	0.136	0.103	0.059	0.053	0.020	0.020	0.007	0.011	0.007	0.086	0.026	455		5.1941	
12 E	4	0.054	0.102	0.161	0.226	0.072	0.052	0.090	0.128	0.050	0.015	0.006	0.005	0.003	0.004	0.006	0.026	796		9.0868	
13 F	1	0.000	0.000	0.250	0.000	0.000	0.250	0.000	0.000	0.250	0.000	0.250	0.000	0.000	0.000	0.000	0.000	4		0.0457	
14 F	2	0.063	0.052	0.095	0.095	0.112	0.101	0.103	0.071	0.063	0.045	0.032	0.034	0.024	0.047	0.026	0.037	464		5.2968	
15 F	3	0.059	0.071	0.121	0.126	0.111	0.086	0.094	0.086	0.049	0.034	0.020	0.012	0.025	0.027	0.030	0.049	406		4.6347	
17 R1	3	0.032	0.000	0.048	0.016	0.016	0.032	0.063	0.119	0.270	0.151	0.087	0.032	0.032	0.016	0.032	0.056	126		1.4384	
18 R1	16	0.029	0.015	0.015	0.059	0.029	0.044	0.029	0.059	0.147	0.132	0.118	0.118	0.044	0.059	0.015	0.088	68		0.7763	
19 R1	32	0.000	0.024	0.012	0.024	0.000	0.071	0.129	0.106	0.118	0.118	0.094	0.059	0.047	0.071	0.059	0.071	85		0.9703	
20 R1	80	0.037	0.027	0.005	0.048	0.069	0.043	0.101	0.112	0.133	0.117	0.043	0.053	0.059	0.048	0.064	0.043	188		2.1461	
21 R2	3	0.015	0.015	0.000	0.015	0.076	0.045	0.045	0.121	0.258	0.212	0.061	0.015	0.030	0.030	0.000	0.061	66		0.7534	
22 R2	16	0.097	0.032	0.000	0.032	0.032	0.032	0.032	0.161	0.065	0.258	0.032	0.000	0.032	0.097	0.065	0.032	31		0.3539	
23 R2	32	0.000	0.024	0.000	0.000	0.000	0.048	0.048	0.071	0.214	0.167	0.071	0.143	0.000	0.095	0.048	0.071	42		0.4795	
24 R2	80	0.043	0.022	0.011	0.000	0.011	0.011	0.022	0.118	0.118	0.183	0.086	0.086	0.108	0.075	0.075	0.032	93		1.0616	
25 R3	3	0.039	0.010	0.019	0.019	0.058	0.039	0.107	0.204	0.204	0.136	0.039	0.029	0.058	0.010	0.010	0.019	103		1.1758	
26 R3	16	0.000	0.000	0.038	0.038	0.038	0.000	0.154	0.192	0.000	0.154	0.231	0.038	0.077	0.000	0.000	0.038	26		0.2968	
27 R3	32	0.064	0.021	0.000	0.021	0.000	0.064	0.021	0.106	0.106	0.106	0.149	0.128	0.106	0.021	0.085	0.000	47		0.5365	
28 R3	80	0.027	0.018	0.009	0.009	0.009	0.045	0.045	0.063	0.099	0.198	0.081	0.045	0.045	0.090	0.072	0.144	111		1.2671	
29 ALL		0.049	0.047	0.063	0.079	0.092	0.119	0.088	0.080	0.075	0.060	0.040	0.033	0.029	0.045	0.051	0.050	8760			

B.2 COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTION

1992 RFP Meteorological Data, EPA Method of Determining Stability Class
Ground-Level χ/Q (s/m^3) at 1900 meters; roughness length = 10 cm.

The data presented here were derived from 1460 weather sequences in which one starting time was randomly selected from each six hour period throughout the year.

χ/Q	Prob $\geq$
1.00E-07	1.00E+00
2.00E-07	9.42E-01
3.00E-07	9.10E-01
5.00E-07	8.88E-01
7.00E-07	8.66E-01
1.00E-06	8.34E-01
2.00E-06	8.05E-01
3.00E-06	7.66E-01
5.00E-06	7.10E-01
7.00E-06	6.52E-01
1.00E-05	5.45E-01
2.00E-05	3.17E-01
3.00E-05	1.82E-01
5.00E-05	1.13E-01
7.00E-05	1.08E-01
1.00E-04	7.60E-02
2.00E-04	2.05E-03
2.21E-04	6.85E-04

This CCDF is shown graphically on the next page. The 50th percentile (median), 95th percentile, and 99.5th percentile points are indicated on the figure.

CCDF of X/Q at 1900 Meters, Roughness Length = 10 cm
1992 RFP Meteorological Data, EPA Method of Determining Stability Class

APPENDIX C

MAXIMUM OFFSITE INDIVIDUAL Constant Weather

One gram WG Pu, 10-minute ground-level release, roughness length = 10 cm

- Set 1: Unfavorable Conditions: 1 m/s wind, Class F stability, 268 m mixing layer ht, with two figures: EDE (Sv) vs distance for "no fire" and "with fire". Note: For "with fire", the plume rises quickly and reaches its full height by the time it reaches the second range (391 m). Because the plume is narrow there is almost no inhalation dose for the 100 and 391 m ranges and cloudshine is the main contributor for these two ranges.
- Set 2: Typical Conditions: 4.5 m/s wind, Class D stability, 1000 m mixing layer ht, with two figures: EDE (Sv) vs distance for "no fire" and "with fire". Note: For "with fire", the plume doesn't reach its full height until the fourth range (4020 m) because the wind speed is higher than in Set 1. This causes the χ/Q values to show a dip at the second range; because the plume is wide, inhalation dose dominates at all ranges.

Explanation of column headings:

Plume characteristics for ^{239}Pu

- Distance: distance of center of range interval from release point (m)
GL AirCon: centerline integrated ground-level air concentration of ^{239}Pu (Bq s/m^3)
GrnCon: centerline ground concentration of ^{239}Pu after plume passage (Bq/m^2)
GL X/Q: average centerline ground-level dispersion factor, χ/Q (s/m^3)
Sigma Y: horizontal measure of plume, averaged over range interval (m)
Sigma Z: vertical measure of plume, averaged over range interval (m)

Centerline Doses (Sv) for Weapons Grade Plutonium

- Skeleton: dose to bone surface (Sv), averaged over range interval
Lungs: dose to lungs (Sv), averaged over range interval
Liver: dose to liver (Sv), averaged over range interval
EDE: effective dose equivalent, whole body (Sv), averaged over range interval

MOI PLUME CHARACTERISTICS AND DOSES

One gram WG Pu, Class F, 1.0 m/s, 10 Minute Release, Roughness Length = 10 cm

PLUME CHARACTERISTICS FOR PU-239						CENTERLINE DOSES (Sv) FOR WEAPONS-GRADE PLUTONIUM							
Distance (m)	GL AirCon Bq s/m ³	GrnCon (Bq/m ²)	GL X/Q (s/m ³)	Sigma Y (m)	Sigma Z (m)	50-YEAR COMMITMENT				70-YEAR COMMITMENT			
						Skeleton	Lungs	Liver	EDE	Skeleton	Lungs	Liver	EDE
No fire, no deposition													
100	4.50E+07	0.00E+00	2.11E-02	4.51E+00	3.34E+00	2.18E+01	6.95E+00	4.75E+00	2.05E+00	2.96E+01	7.85E+00	5.94E+00	2.56E+00
391	4.79E+06	0.00E+00	2.25E-03	1.58E+01	8.98E+00	2.32E+00	7.38E-01	5.05E-01	2.17E-01	3.14E+00	8.34E-01	6.31E-01	2.72E-01
1900	4.71E+05	0.00E+00	2.21E-04	6.46E+01	2.23E+01	2.28E-01	7.27E-02	4.97E-02	2.14E-02	3.09E-01	8.21E-02	6.21E-02	2.68E-02
4020	1.40E+05	0.00E+00	6.55E-05	1.30E+02	3.74E+01	6.77E-02	2.15E-02	1.47E-02	6.35E-03	9.18E-02	2.43E-02	1.84E-02	7.95E-03
5630	8.39E+04	0.00E+00	3.94E-05	1.76E+02	4.59E+01	4.07E-02	1.29E-02	8.86E-03	3.81E-03	5.51E-02	1.46E-02	1.11E-02	4.78E-03
7240	5.74E+04	0.00E+00	2.70E-05	2.21E+02	5.34E+01	2.78E-02	8.86E-03	6.06E-03	2.61E-03	3.77E-02	1.00E-02	7.58E-03	3.27E-03
12100	2.71E+04	0.00E+00	1.27E-05	3.49E+02	7.18E+01	1.31E-02	4.18E-03	2.86E-03	1.23E-03	1.78E-02	4.72E-03	3.57E-03	1.54E-03
24100	9.54E+03	0.00E+00	4.48E-06	6.52E+02	1.09E+02	4.62E-03	1.47E-03	1.01E-03	4.34E-04	6.27E-03	1.66E-03	1.26E-03	5.43E-04
40200	4.38E+03	0.00E+00	2.06E-06	1.04E+03	1.50E+02	2.12E-03	6.76E-04	4.63E-04	1.99E-04	2.88E-03	7.64E-04	5.78E-04	2.50E-04
56300	2.70E+03	0.00E+00	1.27E-06	1.41E+03	1.84E+02	1.31E-03	4.16E-04	2.85E-04	1.23E-04	1.77E-03	4.70E-04	3.56E-04	1.54E-04
72400	1.95E+03	0.00E+00	9.15E-07	1.77E+03	2.14E+02	9.45E-04	3.01E-04	2.06E-04	8.86E-05	1.28E-03	3.40E-04	2.57E-04	1.11E-04
With 6 MW fire, no deposition													
100	1.51E-16	0.00E+00	7.11E-26	4.51E+00	3.34E+00	1.69E-12	9.43E-13	8.27E-13	1.43E-12	1.69E-12	9.43E-13	8.27E-13	1.43E-12
391	4.95E-07	0.00E+00	2.32E-16	1.58E+01	8.98E+00	6.79E-13	3.22E-13	2.67E-13	3.94E-13	7.64E-13	3.32E-13	2.81E-13	4.00E-13
1900	3.69E+03	0.00E+00	1.73E-06	6.46E+01	2.23E+01	1.79E-03	5.69E-04	3.89E-04	1.67E-04	2.42E-03	6.42E-04	4.86E-04	2.10E-04
4020	2.49E+04	0.00E+00	1.17E-05	1.30E+02	3.74E+01	1.21E-02	3.84E-03	2.62E-03	1.13E-03	1.63E-02	4.34E-03	3.28E-03	1.42E-03
5630	2.67E+04	0.00E+00	1.25E-05	1.76E+02	4.59E+01	1.29E-02	4.12E-03	2.82E-03	1.21E-03	1.75E-02	4.65E-03	3.52E-03	1.52E-03
7240	2.47E+04	0.00E+00	1.16E-05	2.21E+02	5.34E+01	1.20E-02	3.81E-03	2.60E-03	1.12E-03	1.62E-02	4.30E-03	3.25E-03	1.40E-03
12100	1.70E+04	0.00E+00	7.96E-06	3.49E+02	7.18E+01	8.21E-03	2.62E-03	1.79E-03	7.70E-04	1.11E-02	2.96E-03	2.24E-03	9.65E-04
24100	7.79E+03	0.00E+00	3.65E-06	6.52E+02	1.09E+02	3.77E-03	1.20E-03	8.22E-04	3.54E-04	5.12E-03	1.36E-03	1.03E-03	4.43E-04
40200	3.96E+03	0.00E+00	1.86E-06	1.04E+03	1.50E+02	1.92E-03	6.11E-04	4.18E-04	1.80E-04	2.60E-03	6.90E-04	5.22E-04	2.25E-04
56300	2.56E+03	0.00E+00	1.20E-06	1.41E+03	1.84E+02	1.24E-03	3.95E-04	2.70E-04	1.16E-04	1.68E-03	4.46E-04	3.38E-04	1.46E-04
72400	1.90E+03	0.00E+00	8.93E-07	1.77E+03	2.14E+02	9.21E-04	2.93E-04	2.01E-04	8.64E-05	1.25E-03	3.31E-04	2.51E-04	1.08E-04

MOI PLUME CHARACTERISTICS AND DOSES

One gram WG Pu, Class F, 1.0 m/s, 10 Minute Release, Roughness Length = 10 cm

PLUME CHARACTERISTICS FOR PU-239						CENTERLINE DOSES (Sv) FOR WEAPONS-GRADE PLUTONIUM							
Distance (m)	GL AirCon Bq s/m ³	GrnCon (Bq/m ²)	GL X/Q (s/m ³)	Sigma Y (m)	Sigma Z (m)	50-YEAR COMMITMENT				70-YEAR COMMITMENT			
						Skeleton	Lungs	Liver	EDE	Skeleton	Lungs	Liver	EDE
No fire, dry deposition velocity = 0.1 cm/s													
100	4.40E+07	4.40E+04	2.11E-02	4.51E+00	3.34E+00	2.13E+01	6.79E+00	4.64E+00	2.00E+00	2.89E+01	7.67E+00	5.80E+00	2.51E+00
391	4.49E+06	4.49E+03	2.25E-03	1.58E+01	8.98E+00	2.17E+00	6.93E-01	4.74E-01	2.04E-01	2.95E+00	7.82E-01	5.92E-01	2.56E-01
1900	4.15E+05	4.14E+02	2.21E-04	6.46E+01	2.23E+01	2.01E-01	6.40E-02	4.38E-02	1.88E-02	2.72E-01	7.23E-02	5.47E-02	2.36E-02
4020	1.15E+05	1.15E+02	6.55E-05	1.30E+02	3.74E+01	5.58E-02	1.78E-02	1.22E-02	5.24E-03	7.57E-02	2.01E-02	1.52E-02	6.56E-03
5630	6.71E+04	6.71E+01	3.94E-05	1.76E+02	4.59E+01	3.25E-02	1.04E-02	7.08E-03	3.05E-03	4.41E-02	1.17E-02	8.85E-03	3.82E-03
7240	4.47E+04	4.47E+01	2.70E-05	2.21E+02	5.34E+01	2.17E-02	6.90E-03	4.72E-03	2.03E-03	2.94E-02	7.80E-03	5.90E-03	2.55E-03
12100	1.99E+04	1.99E+01	1.27E-05	3.49E+02	7.18E+01	9.67E-03	3.08E-03	2.11E-03	9.07E-04	1.31E-02	3.48E-03	2.63E-03	1.14E-03
24100	6.34E+03	6.33E+00	4.48E-06	6.52E+02	1.09E+02	3.07E-03	9.79E-04	6.69E-04	2.88E-04	4.17E-03	1.11E-03	8.37E-04	3.61E-04
40200	2.63E+03	2.63E+00	2.06E-06	1.04E+03	1.50E+02	1.27E-03	4.06E-04	2.77E-04	1.19E-04	1.73E-03	4.58E-04	3.47E-04	1.50E-04
56300	1.49E+03	1.49E+00	1.27E-06	1.41E+03	1.84E+02	7.25E-04	2.31E-04	1.58E-04	6.80E-05	9.83E-04	2.61E-04	1.97E-04	8.51E-05
72400	1.01E+03	1.01E+00	9.15E-07	1.77E+03	2.14E+02	4.89E-04	1.56E-04	1.06E-04	4.59E-05	6.63E-04	1.76E-04	1.33E-04	5.74E-05
With 6 MW fire, dry deposition velocity = 0.1 cm/s													
100	1.51E-16	0.00E+00	7.11E-26	4.51E+00	3.34E+00	1.69E-12	9.43E-13	8.27E-13	1.43E-12	1.69E-12	9.43E-13	8.27E-13	1.43E-12
391	4.95E-07	5.02E-10	2.32E-16	1.58E+01	8.98E+00	6.79E-13	3.22E-13	2.68E-13	3.94E-13	7.65E-13	3.32E-13	2.81E-13	4.00E-13
1900	3.68E+03	3.68E+00	1.73E-06	6.46E+01	2.23E+01	1.79E-03	5.69E-04	3.89E-04	1.68E-04	2.42E-03	6.43E-04	4.86E-04	2.10E-04
4020	2.48E+04	2.48E+01	1.17E-05	1.30E+02	3.74E+01	1.20E-02	3.83E-03	2.62E-03	1.13E-03	1.63E-02	4.32E-03	3.27E-03	1.41E-03
5630	2.64E+04	2.64E+01	1.25E-05	1.76E+02	4.59E+01	1.28E-02	4.08E-03	2.79E-03	1.20E-03	1.74E-02	4.60E-03	3.48E-03	1.50E-03
7240	2.42E+04	2.42E+01	1.16E-05	2.21E+02	5.34E+01	1.17E-02	3.73E-03	2.55E-03	1.10E-03	1.59E-02	4.21E-03	3.19E-03	1.38E-03
12100	1.61E+04	1.61E+01	7.96E-06	3.49E+02	7.18E+01	7.79E-03	2.48E-03	1.70E-03	7.31E-04	1.06E-02	2.80E-03	2.12E-03	9.15E-04
24100	6.85E+03	6.84E+00	3.65E-06	6.52E+02	1.09E+02	3.32E-03	1.06E-03	7.23E-04	3.11E-04	4.50E-03	1.19E-03	9.04E-04	3.90E-04
40200	3.19E+03	3.19E+00	1.86E-06	1.04E+03	1.50E+02	1.55E-03	4.92E-04	3.37E-04	1.45E-04	2.10E-03	5.56E-04	4.21E-04	1.82E-04
56300	1.92E+03	1.91E+00	1.20E-06	1.41E+03	1.84E+02	9.29E-04	2.96E-04	2.02E-04	8.71E-05	1.26E-03	3.34E-04	2.53E-04	1.09E-04
72400	1.33E+03	1.33E+00	8.93E-07	1.77E+03	2.14E+02	6.46E-04	2.06E-04	1.41E-04	6.06E-05	8.76E-04	2.32E-04	1.76E-04	7.59E-05

MOI PLUME CHARACTERISTICS AND DOSES

One gram WG Pu, Class F, 1.0 m/s, 10 Minute Release, Roughness Length = 10 cm

PLUME CHARACTERISTICS FOR PU-239						CENTERLINE DOSES (Sv) FOR WEAPONS-GRADE PLUTONIUM							
Distance (m)	GL AirCon Bq s/m ³	GrnCon (Bq/m ²)	GL X/Q (s/m ³)	Sigma Y (m)	Sigma Z (m)	50-YEAR COMMITMENT				70-YEAR COMMITMENT			
						Skeleton	Lungs	Liver	EDE	Skeleton	Lungs	Liver	EDE
No fire, dry deposition velocity = 1.0 cm/s													
100	3.65E+07	3.58E+05	2.11E-02	4.51E+00	3.34E+00	1.78E+01	5.66E+00	3.87E+00	1.67E+00	2.41E+01	6.40E+00	4.84E+00	2.09E+00
391	2.54E+06	2.52E+04	2.25E-03	1.58E+01	8.98E+00	1.24E+00	3.95E-01	2.70E-01	1.16E-01	1.68E+00	4.46E-01	3.37E-01	1.46E-01
1900	1.45E+05	1.35E+03	2.21E-04	6.46E+01	2.23E+01	7.05E-02	2.25E-02	1.54E-02	6.61E-03	9.56E-02	2.54E-02	1.92E-02	8.28E-03
4020	2.05E+04	2.03E+02	6.55E-05	1.30E+02	3.74E+01	1.00E-02	3.19E-03	2.18E-03	9.40E-04	1.36E-02	3.60E-03	2.73E-03	1.18E-03
5630	9.00E+03	8.94E+01	3.94E-05	1.76E+02	4.59E+01	4.39E-03	1.40E-03	9.56E-04	4.12E-04	5.95E-03	1.58E-03	1.19E-03	5.16E-04
7240	4.74E+03	4.71E+01	2.70E-05	2.21E+02	5.34E+01	2.31E-03	7.35E-04	5.03E-04	2.17E-04	3.13E-03	8.31E-04	6.29E-04	2.71E-04
12100	1.39E+03	1.30E+01	1.27E-05	3.49E+02	7.18E+01	6.75E-04	2.15E-04	1.47E-04	6.33E-05	9.16E-04	2.43E-04	1.84E-04	7.93E-05
24100	1.85E+02	1.66E+00	4.48E-06	6.52E+02	1.09E+02	9.03E-05	2.88E-05	1.97E-05	8.47E-06	1.22E-04	3.25E-05	2.46E-05	1.06E-05
40200	2.85E+01	2.68E-01	2.06E-06	1.04E+03	1.50E+02	1.39E-05	4.42E-06	3.02E-06	1.30E-06	1.88E-05	4.99E-06	3.78E-06	1.63E-06
56300	7.75E+00	7.43E-02	1.27E-06	1.41E+03	1.84E+02	3.78E-06	1.20E-06	8.22E-07	3.54E-07	5.12E-06	1.36E-06	1.03E-06	4.44E-07
72400	2.79E+00	2.69E-02	9.15E-07	1.77E+03	2.14E+02	1.36E-06	4.33E-07	2.96E-07	1.27E-07	1.84E-06	4.89E-07	3.70E-07	1.60E-07
With 6 MW fire, dry deposition velocity = 1.0 cm/s													
100	1.51E-16	0.00E+00	7.11E-26	4.51E+00	3.34E+00	1.69E-12	9.43E-13	8.27E-13	1.43E-12	1.69E-12	9.43E-13	8.27E-13	1.43E-12
391	4.95E-07	4.95E-09	2.32E-16	1.58E+01	8.98E+00	6.81E-13	3.22E-13	2.68E-13	3.95E-13	7.67E-13	3.32E-13	2.81E-13	4.00E-13
1900	3.67E+03	3.67E+01	1.73E-06	6.46E+01	2.23E+01	1.79E-03	5.70E-04	3.90E-04	1.68E-04	2.43E-03	6.44E-04	4.88E-04	2.10E-04
4020	2.40E+04	2.40E+02	1.17E-05	1.30E+02	3.74E+01	1.17E-02	3.72E-03	2.54E-03	1.10E-03	1.58E-02	4.20E-03	3.18E-03	1.37E-03
5630	2.39E+04	2.39E+02	1.25E-05	1.76E+02	4.59E+01	1.16E-02	3.71E-03	2.53E-03	1.09E-03	1.58E-02	4.19E-03	3.17E-03	1.37E-03
7240	2.00E+04	2.00E+02	1.16E-05	2.21E+02	5.34E+01	9.77E-03	3.11E-03	2.13E-03	9.17E-04	1.33E-02	3.52E-03	2.66E-03	1.15E-03
12100	1.03E+04	1.00E+02	7.96E-06	3.49E+02	7.18E+01	5.00E-03	1.59E-03	1.09E-03	4.69E-04	6.79E-03	1.80E-03	1.36E-03	5.88E-04
24100	2.37E+03	2.20E+01	3.65E-06	6.52E+02	1.09E+02	1.15E-03	3.68E-04	2.52E-04	1.08E-04	1.57E-03	4.15E-04	3.14E-04	1.36E-04
40200	4.86E+02	4.63E+00	1.86E-06	1.04E+03	1.50E+02	2.37E-04	7.54E-05	5.16E-05	2.22E-05	3.21E-04	8.52E-05	6.45E-05	2.78E-05
56300	1.49E+02	1.43E+00	1.20E-06	1.41E+03	1.84E+02	7.26E-05	2.31E-05	1.58E-05	6.81E-06	9.84E-05	2.61E-05	1.98E-05	8.53E-06
72400	5.68E+01	5.50E-01	8.93E-07	1.77E+03	2.14E+02	2.77E-05	8.82E-06	6.04E-06	2.60E-06	3.76E-05	9.97E-06	7.54E-06	3.26E-06

**EDE (Sv), PLUME CENTERLINE, NO FIRE
STABILITY CLASS F, 1 M/S WIND SPEED**

Dry deposition velocity

- $V = 0 \text{ cm/s}$
- $V = 0.1 \text{ cm/s}$
- ◆— $V = 1.0 \text{ cm/s}$

Straight-line Wind With Rotation,
One Gram WG Pu
Roughness Length = 10 cm
50-Year Commitment

**EDE (Sv), PLUME CENTERLINE, WITH 6 MW FIRE
STABILITY CLASS F, 1 M/S WIND SPEED**

MOI PLUME CHARACTERISTICS AND DOSES

One gram WG Pu, Class D, 4.5 m/s, 10 Minute Release, Roughness Length = 10 cm

PLUME CHARACTERISTICS FOR PU-239						CENTERLINE DOSES (Sv) FOR WEAPONS-GRADE PLUTONIUM							
Distance (m)	GL AirCon Bq s/m ³	GrnCon (Bq/m ²)	GL X/Q (s/m ³)	Sigma Y (m)	Sigma Z (m)	50-YEAR COMMITMENT				70-YEAR COMMITMENT			
						Skeleton	Lungs	Liver	EDE	Skeleton	Lungs	Liver	EDE
No fire, no deposition													
100	2.65E+06	0.00E+00	1.24E-03	9.00E+00	6.33E+00	1.28E+00	4.08E-01	2.79E-01	1.20E-01	1.74E+00	4.61E-01	3.49E-01	1.51E-01
391	2.57E+05	0.00E+00	1.21E-04	3.21E+01	1.83E+01	1.25E-01	3.97E-02	2.71E-02	1.17E-02	1.69E-01	4.48E-02	3.39E-02	1.46E-02
1900	2.31E+04	0.00E+00	1.09E-05	1.32E+02	4.95E+01	1.12E-02	3.57E-03	2.44E-03	1.05E-03	1.52E-02	4.03E-03	3.05E-03	1.32E-03
4020	6.63E+03	0.00E+00	3.11E-06	2.65E+02	8.58E+01	3.21E-03	1.02E-03	6.99E-04	3.01E-04	4.36E-03	1.16E-03	8.74E-04	3.77E-04
5630	3.92E+03	0.00E+00	1.84E-06	3.59E+02	1.07E+02	1.90E-03	6.04E-04	4.13E-04	1.78E-04	2.57E-03	6.82E-04	5.16E-04	2.23E-04
7240	2.64E+03	0.00E+00	1.24E-06	4.51E+02	1.26E+02	1.28E-03	4.08E-04	2.79E-04	1.20E-04	1.74E-03	4.61E-04	3.49E-04	1.51E-04
12100	1.21E+03	0.00E+00	5.70E-07	7.12E+02	1.74E+02	5.88E-04	1.87E-04	1.28E-04	5.52E-05	7.98E-04	2.12E-04	1.60E-04	6.91E-05
24100	4.13E+02	0.00E+00	1.94E-07	1.33E+03	2.74E+02	2.00E-04	6.37E-05	4.36E-05	1.88E-05	2.71E-04	7.19E-05	5.44E-05	2.35E-05
40200	1.84E+02	0.00E+00	8.65E-08	2.12E+03	3.86E+02	8.93E-05	2.84E-05	1.94E-05	8.37E-06	1.21E-04	3.21E-05	2.43E-05	1.05E-05
56300	1.09E+02	0.00E+00	5.11E-08	2.87E+03	4.82E+02	5.27E-05	1.68E-05	1.15E-05	4.95E-06	7.15E-05	1.90E-05	1.44E-05	6.20E-06
72400	7.38E+01	0.00E+00	3.46E-08	3.61E+03	5.69E+02	3.57E-05	1.14E-05	7.79E-06	3.35E-06	4.85E-05	1.29E-05	9.73E-06	4.20E-06
With 6 MW fire, no deposition													
100	4.63E+04	0.00E+00	2.17E-05	9.00E+00	6.33E+00	2.24E-02	7.15E-03	4.89E-03	2.10E-03	3.04E-02	8.07E-03	6.11E-03	2.64E-03
391	2.97E+03	0.00E+00	1.39E-06	3.21E+01	1.83E+01	1.44E-03	4.58E-04	3.13E-04	1.35E-04	1.95E-03	5.17E-04	3.91E-04	1.69E-04
1900	6.40E+03	0.00E+00	3.00E-06	1.32E+02	4.95E+01	3.10E-03	9.87E-04	6.75E-04	2.91E-04	4.20E-03	1.12E-03	8.44E-04	3.64E-04
4020	4.04E+03	0.00E+00	1.90E-06	2.65E+02	8.58E+01	1.96E-03	6.24E-04	4.27E-04	1.84E-04	2.66E-03	7.05E-04	5.33E-04	2.30E-04
5630	2.85E+03	0.00E+00	1.34E-06	3.59E+02	1.07E+02	1.38E-03	4.40E-04	3.01E-04	1.30E-04	1.87E-03	4.97E-04	3.76E-04	1.62E-04
7240	2.11E+03	0.00E+00	9.88E-07	4.51E+02	1.26E+02	1.02E-03	3.25E-04	2.22E-04	9.57E-05	1.38E-03	3.67E-04	2.78E-04	1.20E-04
12100	1.08E+03	0.00E+00	5.05E-07	7.12E+02	1.74E+02	5.22E-04	1.66E-04	1.14E-04	4.89E-05	7.08E-04	1.88E-04	1.42E-04	6.13E-05
24100	3.93E+02	0.00E+00	1.85E-07	1.33E+03	2.74E+02	1.91E-04	6.07E-05	4.15E-05	1.79E-05	2.58E-04	6.85E-05	5.19E-05	2.24E-05
40200	1.80E+02	0.00E+00	8.44E-08	2.12E+03	3.86E+02	8.71E-05	2.77E-05	1.90E-05	8.17E-06	1.18E-04	3.13E-05	2.37E-05	1.02E-05
56300	1.07E+02	0.00E+00	5.03E-08	2.87E+03	4.82E+02	5.19E-05	1.65E-05	1.13E-05	4.87E-06	7.04E-05	1.87E-05	1.41E-05	6.10E-06
72400	7.30E+01	0.00E+00	3.43E-08	3.61E+03	5.69E+02	3.54E-05	1.13E-05	7.70E-06	3.32E-06	4.80E-05	1.27E-05	9.63E-06	4.16E-06

MOI PLUME CHARACTERISTICS AND DOSES

One gram WG Pu, Class D, 4.5 m/s, 10 Minute Release, Roughness Length = 10 cm

PLUME CHARACTERISTICS FOR PU-239						CENTERLINE DOSES (Sv) FOR WEAPONS-GRADE PLUTONIUM							
Distance (m)	GL AirCon Bq s/m ³	GrnCon (Bq/m ²)	GL X/Q (s/m ³)	Sigma Y (m)	Sigma Z (m)	50-YEAR COMMITMENT				70-YEAR COMMITMENT			
						Skeleton	Lungs	Liver	EDE	Skeleton	Lungs	Liver	EDE
No fire, dry deposition velocity = 0.1 cm/s													
100	2.64E+06	2.64E+03	1.24E-03	9.00E+00	6.33E+00	1.28E+00	4.07E-01	2.79E-01	1.20E-01	1.74E+00	4.60E-01	3.48E-01	1.50E-01
391	2.55E+05	2.55E+02	1.21E-04	3.21E+01	1.83E+01	1.24E-01	3.94E-02	2.69E-02	1.16E-02	1.68E-01	4.45E-02	3.37E-02	1.45E-02
1900	2.28E+04	2.28E+01	1.09E-05	1.32E+02	4.95E+01	1.11E-02	3.52E-03	2.41E-03	1.04E-03	1.50E-02	3.98E-03	3.01E-03	1.30E-03
4020	6.50E+03	6.50E+00	3.11E-06	2.65E+02	8.58E+01	3.15E-03	1.00E-03	6.86E-04	2.95E-04	4.27E-03	1.13E-03	8.57E-04	3.70E-04
5630	3.82E+03	3.82E+00	1.84E-06	3.59E+02	1.07E+02	1.85E-03	5.91E-04	4.04E-04	1.74E-04	2.51E-03	6.67E-04	5.05E-04	2.18E-04
7240	2.58E+03	2.58E+00	1.24E-06	4.51E+02	1.26E+02	1.25E-03	3.98E-04	2.72E-04	1.17E-04	1.69E-03	4.49E-04	3.40E-04	1.47E-04
12100	1.18E+03	1.18E+00	5.70E-07	7.12E+02	1.74E+02	5.71E-04	1.82E-04	1.24E-04	5.35E-05	7.74E-04	2.05E-04	1.55E-04	6.70E-05
24100	3.96E+02	3.96E-01	1.94E-07	1.33E+03	2.74E+02	1.92E-04	6.12E-05	4.19E-05	1.80E-05	2.61E-04	6.91E-05	5.23E-05	2.26E-05
40200	1.75E+02	1.75E-01	8.65E-08	2.12E+03	3.86E+02	8.50E-05	2.71E-05	1.85E-05	7.97E-06	1.15E-04	3.06E-05	2.31E-05	9.99E-06
56300	1.03E+02	1.03E-01	5.11E-08	2.87E+03	4.82E+02	4.99E-05	1.59E-05	1.09E-05	4.68E-06	6.77E-05	1.80E-05	1.36E-05	5.86E-06
72400	6.94E+01	6.94E-02	3.46E-08	3.61E+03	5.69E+02	3.36E-05	1.07E-05	7.33E-06	3.15E-06	4.56E-05	1.21E-05	9.16E-06	3.95E-06
With 6 MW fire, dry deposition velocity = 0.1 cm/s													
100	4.63E+04	4.63E+01	2.17E-05	9.00E+00	6.33E+00	2.25E-02	7.15E-03	4.89E-03	2.11E-03	3.04E-02	8.08E-03	6.11E-03	2.64E-03
391	2.97E+03	2.97E+00	1.39E-06	3.21E+01	1.83E+01	1.44E-03	4.58E-04	3.13E-04	1.35E-04	1.95E-03	5.17E-04	3.91E-04	1.69E-04
1900	6.39E+03	6.39E+00	3.00E-06	1.32E+02	4.95E+01	3.10E-03	9.87E-04	6.75E-04	2.91E-04	4.20E-03	1.11E-03	8.43E-04	3.64E-04
4020	4.03E+03	4.03E+00	1.90E-06	2.65E+02	8.58E+01	1.95E-03	6.22E-04	4.25E-04	1.83E-04	2.65E-03	7.03E-04	5.32E-04	2.29E-04
5630	2.84E+03	2.84E+00	1.34E-06	3.59E+02	1.07E+02	1.37E-03	4.38E-04	2.99E-04	1.29E-04	1.86E-03	4.94E-04	3.74E-04	1.61E-04
7240	2.09E+03	2.09E+00	9.88E-07	4.51E+02	1.26E+02	1.01E-03	3.23E-04	2.21E-04	9.50E-05	1.37E-03	3.64E-04	2.76E-04	1.19E-04
12100	1.06E+03	1.06E+00	5.05E-07	7.12E+02	1.74E+02	5.16E-04	1.64E-04	1.12E-04	4.84E-05	7.00E-04	1.86E-04	1.40E-04	6.06E-05
24100	3.85E+02	3.85E-01	1.85E-07	1.33E+03	2.74E+02	1.87E-04	5.95E-05	4.07E-05	1.75E-05	2.53E-04	6.72E-05	5.08E-05	2.19E-05
40200	1.75E+02	1.75E-01	8.44E-08	2.12E+03	3.86E+02	8.46E-05	2.70E-05	1.84E-05	7.94E-06	1.15E-04	3.05E-05	2.30E-05	9.95E-06
56300	1.03E+02	1.03E-01	5.03E-08	2.87E+03	4.82E+02	5.01E-05	1.60E-05	1.09E-05	4.70E-06	6.80E-05	1.80E-05	1.36E-05	5.89E-06
72400	7.01E+01	7.01E-02	3.43E-08	3.61E+03	5.69E+02	3.40E-05	1.08E-05	7.40E-06	3.18E-06	4.61E-05	1.22E-05	9.25E-06	3.99E-06

MOI PLUME CHARACTERISTICS AND DOSES

One gram WG Pu, Class D, 4.5 m/s, 10 Minute Release, Roughness Length = 10 cm

PLUME CHARACTERISTICS FOR PU-239						CENTERLINE DOSES (Sv) FOR WEAPONS-GRADE PLUTONIUM							
Distance (m)	GL AirCon Bq s/m ³	GmCon (Bq/m ²)	GL X/Q (s/m ³)	Sigma Y (m)	Sigma Z (m)	50-YEAR COMMITMENT				70-YEAR COMMITMENT			
						Skeleton	Lungs	Liver	EDE	Skeleton	Lungs	Liver	EDE
No fire, dry deposition velocity = 1.0 cm/s													
100	2.57E+06	2.57E+04	1.24E-03	9.00E+00	6.33E+00	1.26E+00	4.00E-01	2.73E-01	1.18E-01	1.70E+00	4.52E-01	3.42E-01	1.47E-01
391	2.39E+05	2.39E+03	1.21E-04	3.21E+01	1.83E+01	1.16E-01	3.71E-02	2.54E-02	1.09E-02	1.58E-01	4.19E-02	3.17E-02	1.37E-02
1900	2.01E+04	2.01E+02	1.09E-05	1.32E+02	4.95E+01	9.82E-03	3.13E-03	2.14E-03	9.21E-04	1.33E-02	3.53E-03	2.67E-03	1.15E-03
4020	5.41E+03	5.40E+01	3.11E-06	2.65E+02	8.58E+01	2.64E-03	8.39E-04	5.74E-04	2.47E-04	3.57E-03	9.48E-04	7.18E-04	3.10E-04
5630	3.10E+03	3.10E+01	1.84E-06	3.59E+02	1.07E+02	1.51E-03	4.81E-04	3.29E-04	1.42E-04	2.05E-03	5.44E-04	4.11E-04	1.78E-04
7240	2.04E+03	2.04E+01	1.24E-06	4.51E+02	1.26E+02	9.96E-04	3.17E-04	2.17E-04	9.34E-05	1.35E-03	3.58E-04	2.71E-04	1.17E-04
12100	8.90E+02	8.90E+00	5.70E-07	7.12E+02	1.74E+02	4.34E-04	1.38E-04	9.46E-05	4.07E-05	5.89E-04	1.56E-04	1.18E-04	5.10E-05
24100	2.76E+02	2.76E+00	1.94E-07	1.33E+03	2.74E+02	1.35E-04	4.29E-05	2.93E-05	1.26E-05	1.83E-04	4.84E-05	3.66E-05	1.58E-05
40200	1.13E+02	1.13E+00	8.65E-08	2.12E+03	3.86E+02	5.49E-05	1.75E-05	1.20E-05	5.15E-06	7.45E-05	1.98E-05	1.50E-05	6.45E-06
56300	6.22E+01	6.22E-01	5.11E-08	2.87E+03	4.82E+02	3.03E-05	9.66E-06	6.61E-06	2.85E-06	4.12E-05	1.09E-05	8.26E-06	3.57E-06
72400	3.99E+01	3.99E-01	3.46E-08	3.61E+03	5.69E+02	1.95E-05	6.20E-06	4.24E-06	1.83E-06	2.64E-05	7.01E-06	5.30E-06	2.29E-06
With 6 MW fire, dry deposition velocity = 1.0 cm/s													
100	4.63E+04	4.63E+02	2.17E-05	9.00E+00	6.33E+00	2.26E-02	7.19E-03	4.92E-03	2.12E-03	3.06E-02	8.12E-03	6.15E-03	2.65E-03
391	2.96E+03	2.96E+01	1.39E-06	3.21E+01	1.83E+01	1.44E-03	4.60E-04	3.15E-04	1.35E-04	1.96E-03	5.20E-04	3.93E-04	1.70E-04
1900	6.31E+03	6.31E+01	3.00E-06	1.32E+02	4.95E+01	3.08E-03	9.80E-04	6.70E-04	2.88E-04	4.17E-03	1.11E-03	8.37E-04	3.61E-04
4020	3.89E+03	3.89E+01	1.90E-06	2.65E+02	8.58E+01	1.90E-03	6.05E-04	4.14E-04	1.78E-04	2.57E-03	6.83E-04	5.17E-04	2.23E-04
5630	2.69E+03	2.69E+01	1.34E-06	3.59E+02	1.07E+02	1.31E-03	4.18E-04	2.86E-04	1.23E-04	1.78E-03	4.72E-04	3.57E-04	1.54E-04
7240	1.95E+03	1.95E+01	9.88E-07	4.51E+02	1.26E+02	9.51E-04	3.03E-04	2.07E-04	8.92E-05	1.29E-03	3.42E-04	2.59E-04	1.12E-04
12100	9.55E+02	9.54E+00	5.05E-07	7.12E+02	1.74E+02	4.65E-04	1.48E-04	1.01E-04	4.36E-05	6.31E-04	1.67E-04	1.27E-04	5.47E-05
24100	3.20E+02	3.20E+00	1.85E-07	1.33E+03	2.74E+02	1.56E-04	4.97E-05	3.40E-05	1.46E-05	2.12E-04	5.61E-05	4.25E-05	1.83E-05
40200	1.34E+02	1.34E+00	8.44E-08	2.12E+03	3.86E+02	6.54E-05	2.08E-05	1.43E-05	6.14E-06	8.87E-05	2.35E-05	1.78E-05	7.69E-06
56300	7.49E+01	7.49E-01	5.03E-08	2.87E+03	4.82E+02	3.65E-05	1.16E-05	7.96E-06	3.43E-06	4.95E-05	1.31E-05	9.95E-06	4.29E-06
72400	4.84E+01	4.83E-01	3.43E-08	3.61E+03	5.69E+02	2.36E-05	7.51E-06	5.14E-06	2.21E-06	3.20E-05	8.48E-06	6.42E-06	2.77E-06

**EDE (Sv), PLUME CENTERLINE, NO FIRE
STABILITY CLASS D, 4 M/S WIND SPEED**

**EDE (Sv), PLUME CENTERLINE, WITH 6 MW FIRE
STABILITY CLASS D, 4.5 M/S WIND SPEED**

APPENDIX D

RISK COMPUTATIONS FOR POPULATION WITHIN 50 MILES Constant Weather - Unfavorable Conditions (Class F, 1 m/s)

One gram WG Pu, 10-minute ground-level release, roughness length = 24 cm
Straight-line wind with rotation
50-Year Exposure, 70-Year Commitment

Explanation of column headings:

Plume characteristics for ^{239}Pu

DISTANCE: distance of center of range interval from release point (m)
GL AIRCON: centerline integrated ground-level air concentration of ^{239}Pu (Bq s/m^3)
GRNCON: centerline ground concentration after plume passage (Bq/m^2)
GL X/Q: average centerline ground-level dispersion factor, χ/Q (s/m^3)
WETREM: fraction of material remaining after wet deposition upon leaving range interval
DRYREM: fraction of material remaining after dry deposition upon leaving range interval
REMINV: adjusted source strength of plume upon entering range interval (Bq)
PLSIGY: horizontal measure of plume, averaged over range interval (m)
PLSIGZ: vertical measure of plume, averaged over range interval (m)

Plume centerline risks (all isotopes of WG Pu)

OVERALL: centerline LCF risk per person, combined EARLY and CHRONC
EARLY: centerline LCF risk person from EARLY module
CHRONC: centerline LCF risk person from CHRONC module

NOTE: For "with fire", the 100 m and 391 m values of risk are dominated by cloudshine. At these distances, the plume is too high for an individual at ground level to receive a significant inhalation dose; cloudshine is essentially the only contributor to risk.

POP PLUME CHARACTERISTICS AND RISKS											
One gram WG Pu, Class F Stability, Wind Speed = 1.0 m/s, 10 minute release											
Roughness Length = 24 cm, 70-year Commitment Period, 50-Year Exposure Period											
PLUME CHARACTERISTICS FOR Pu-239									CENTERLINE RISK (LCF)		
DISTANCE	GL AIRCON	GRNCON	GL X/Q	WETREM	DRYREM	REMINV	PLSIGY	PLSIGZ	OVERALL	EARLY	CHRONC
<i>No fire, no deposition</i>											
100	3.81E+07	0.00E+00	1.79E-02	1.0000	1.0000	2.13E+09	4.51E+00	3.95E+00	2E-02	2.42E-02	0.00E+00
391	4.00E+06	0.00E+00	1.88E-03	1.0000	1.0000	2.13E+09	1.58E+01	1.07E+01	3E-03	2.55E-03	0.00E+00
1900	3.94E+05	0.00E+00	1.85E-04	1.0000	1.0000	2.13E+09	6.46E+01	2.67E+01	3E-04	2.50E-04	0.00E+00
4020	1.17E+05	0.00E+00	5.48E-05	1.0000	1.0000	2.13E+09	1.30E+02	4.48E+01	7E-05	7.43E-05	0.00E+00
5630	7.01E+04	0.00E+00	3.29E-05	1.0000	1.0000	2.13E+09	1.76E+02	5.49E+01	4E-05	4.46E-05	0.00E+00
7240	4.80E+04	0.00E+00	2.25E-05	1.0000	1.0000	2.13E+09	2.21E+02	6.40E+01	3E-05	3.05E-05	0.00E+00
12100	2.26E+04	0.00E+00	1.06E-05	1.0000	1.0000	2.13E+09	3.49E+02	8.59E+01	1E-05	1.44E-05	0.00E+00
24100	7.98E+03	0.00E+00	3.74E-06	1.0000	1.0000	2.13E+09	6.52E+02	1.30E+02	5E-06	5.08E-06	0.00E+00
40200	3.73E+03	0.00E+00	1.75E-06	1.0000	1.0000	2.13E+09	1.04E+03	1.79E+02	2E-06	2.38E-06	0.00E+00
56300	2.42E+03	0.00E+00	1.13E-06	1.0000	1.0000	2.13E+09	1.41E+03	2.20E+02	2E-06	1.54E-06	0.00E+00
72400	1.84E+03	0.00E+00	8.61E-07	1.0000	1.0000	2.13E+09	1.77E+03	2.56E+02	1E-06	1.17E-06	0.00E+00
<i>With 6 MW fire, no deposition</i>											
100	5.58E-10	0.00E+00	2.62E-19	1.0000	1.0000	2.13E+09	4.51E+00	3.95E+00	6E-15	6.03E-15	0.00E+00
391	3.28E-03	0.00E+00	1.54E-12	1.0000	1.0000	2.13E+09	1.58E+01	1.07E+01	2E-12	2.09E-12	0.00E+00
1900	1.33E+04	0.00E+00	6.24E-06	1.0000	1.0000	2.13E+09	6.46E+01	2.67E+01	8E-06	8.46E-06	0.00E+00
4020	3.50E+04	0.00E+00	1.64E-05	1.0000	1.0000	2.13E+09	1.30E+02	4.48E+01	2E-05	2.23E-05	0.00E+00
5630	3.15E+04	0.00E+00	1.48E-05	1.0000	1.0000	2.13E+09	1.76E+02	5.49E+01	2E-05	2.01E-05	0.00E+00
7240	2.66E+04	0.00E+00	1.25E-05	1.0000	1.0000	2.13E+09	2.21E+02	6.40E+01	2E-05	1.69E-05	0.00E+00
12100	1.63E+04	0.00E+00	7.66E-06	1.0000	1.0000	2.13E+09	3.49E+02	8.59E+01	1E-05	1.04E-05	0.00E+00
24100	6.93E+03	0.00E+00	3.25E-06	1.0000	1.0000	2.13E+09	6.52E+02	1.30E+02	4E-06	4.41E-06	0.00E+00
40200	3.52E+03	0.00E+00	1.65E-06	1.0000	1.0000	2.13E+09	1.04E+03	1.79E+02	2E-06	2.24E-06	0.00E+00
56300	2.37E+03	0.00E+00	1.11E-06	1.0000	1.0000	2.13E+09	1.41E+03	2.20E+02	2E-06	1.51E-06	0.00E+00
72400	1.82E+03	0.00E+00	8.55E-07	1.0000	1.0000	2.13E+09	1.77E+03	2.56E+02	1E-06	1.16E-06	0.00E+00

POP PLUME CHARACTERISTICS AND RISKS											
One gram WG Pu, Class F Stability, Wind Speed = 1.0 m/s, 10 minute release											
Roughness Length = 24 cm, 70-year Commitment Period, 50-Year Exposure Period											
PLUME CHARACTERISTICS FOR Pu-239									CENTERLINE RISK (LCF)		
DISTANCE	GL AIRCON	GRNCON	GL X/Q	WETREM	DRYREM	REMINV	PLSIGY	PLSIGZ	OVERALL	EARLY	CHRONC
<i>No fire, deposition velocity = 0.1 cm/s</i>											
100	3.74E+07	3.74E+04	1.79E-02	1.0000	0.9604	2.13E+09	4.51E+00	3.95E+00	3E-02	2.43E-02	1.70E-03
391	3.79E+06	3.79E+03	1.88E-03	1.0000	0.9721	2.05E+09	1.58E+01	1.07E+01	3E-03	2.47E-03	1.54E-04
1900	3.54E+05	3.53E+02	1.85E-04	1.0000	0.9242	1.99E+09	6.46E+01	2.67E+01	2E-04	2.30E-04	1.20E-05
4020	9.93E+04	9.93E+01	5.48E-05	1.0000	0.9717	1.84E+09	1.30E+02	4.48E+01	7E-05	6.47E-05	3.21E-06
5630	5.81E+04	5.81E+01	3.29E-05	1.0000	0.9769	1.79E+09	1.76E+02	5.49E+01	4E-05	3.79E-05	1.82E-06
7240	3.89E+04	3.89E+01	2.25E-05	1.0000	0.9801	1.75E+09	2.21E+02	6.40E+01	3E-05	2.54E-05	1.19E-06
12100	1.75E+04	1.75E+01	1.06E-05	1.0000	0.9280	1.71E+09	3.49E+02	8.59E+01	1E-05	1.14E-05	5.09E-07
24100	5.66E+03	5.66E+00	3.74E-06	1.0000	0.9061	1.59E+09	6.52E+02	1.30E+02	4E-06	3.69E-06	1.54E-07
40200	2.43E+03	2.43E+00	1.75E-06	1.0000	0.9293	1.44E+09	1.04E+03	1.79E+02	2E-06	1.58E-06	6.32E-08
56300	1.47E+03	1.47E+00	1.13E-06	1.0000	0.9376	1.34E+09	1.41E+03	2.20E+02	1E-06	9.57E-07	3.70E-08
72400	1.05E+03	1.05E+00	8.61E-07	1.0000	0.9404	1.25E+09	1.77E+03	2.56E+02	7E-07	6.82E-07	2.58E-08
<i>With 6 MW fire, deposition velocity = 0.1 cm/s</i>											
100	5.58E-10	0.00E+00	2.62E-19	1.0000	1.0000	2.13E+09	4.51E+00	3.95E+00	6E-15	6.03E-15	0.00E+00
391	3.28E-03	3.28E-06	1.54E-12	1.0000	1.0000	2.13E+09	1.58E+01	1.07E+01	2E-12	2.14E-12	1.33E-13
1900	1.33E+04	1.33E+01	6.24E-06	1.0000	0.9973	2.13E+09	6.46E+01	2.67E+01	9E-06	8.65E-06	4.51E-07
4020	3.47E+04	3.47E+01	1.64E-05	1.0000	0.9914	2.13E+09	1.30E+02	4.48E+01	2E-05	2.26E-05	1.12E-06
5630	3.10E+04	3.10E+01	1.48E-05	1.0000	0.9896	2.11E+09	1.76E+02	5.49E+01	2E-05	2.02E-05	9.73E-07
7240	2.59E+04	2.59E+01	1.25E-05	1.0000	0.9889	2.09E+09	2.21E+02	6.40E+01	2E-05	1.69E-05	7.94E-07
12100	1.54E+04	1.54E+01	7.66E-06	1.0000	0.9476	2.06E+09	3.49E+02	8.59E+01	1E-05	1.00E-05	4.47E-07
24100	6.10E+03	6.09E+00	3.25E-06	1.0000	0.9179	1.95E+09	6.52E+02	1.30E+02	4E-06	3.97E-06	1.66E-07
40200	2.86E+03	2.86E+00	1.65E-06	1.0000	0.9332	1.79E+09	1.04E+03	1.79E+02	2E-06	1.87E-06	7.44E-08
56300	1.80E+03	1.80E+00	1.11E-06	1.0000	0.9389	1.67E+09	1.41E+03	2.20E+02	1E-06	1.17E-06	4.54E-08
72400	1.30E+03	1.30E+00	8.55E-07	1.0000	0.9408	1.57E+09	1.77E+03	2.56E+02	9E-07	8.50E-07	3.21E-08

POP PLUME CHARACTERISTICS AND RISKS											
One gram WG Pu, Class F Stability, Wind Speed = 1.0 m/s, 10 minute release											
Roughness Length = 24 cm, 70-year Commitment Period, 50-Year Exposure Period											
PLUME CHARACTERISTICS FOR Pu-239									CENTERLINE RISK (LCF)		
DISTANCE	GL AIRCON	GRNCON	GL X/Q	WETREM	DRYREM	REMINV	PLSIGY	PLSIGZ	OVERALL	EARLY	CHRONC
<i>No fire, deposition velocity = 1 cm/s</i>											
100	3.18E+07	3.14E+05	1.79E-02	1.0000	0.6673	2.13E+09	4.51E+00	3.95E+00	4E-02	2.49E-02	1.42E-02
391	2.34E+06	2.33E+04	1.88E-03	1.0000	0.7535	1.42E+09	1.58E+01	1.07E+01	3E-03	1.84E-03	9.48E-04
1900	1.44E+05	1.37E+03	1.85E-04	1.0000	0.4545	1.07E+09	6.46E+01	2.67E+01	2E-04	1.12E-04	4.66E-05
4020	2.33E+04	2.32E+02	5.48E-05	1.0000	0.7506	4.87E+08	1.30E+02	4.48E+01	3E-05	1.84E-05	7.51E-06
5630	1.08E+04	1.07E+02	3.29E-05	1.0000	0.7916	3.66E+08	1.76E+02	5.49E+01	1E-05	8.48E-06	3.37E-06
7240	5.92E+03	5.90E+01	2.25E-05	1.0000	0.8181	2.89E+08	2.21E+02	6.40E+01	6E-06	4.66E-06	1.81E-06
12100	1.85E+03	1.77E+01	1.06E-05	1.0000	0.4738	2.37E+08	3.49E+02	8.59E+01	2E-06	1.45E-06	5.15E-07
24100	2.88E+02	2.67E+00	3.74E-06	1.0000	0.3732	1.12E+08	6.52E+02	1.30E+02	3E-07	2.24E-07	7.27E-08
40200	5.43E+01	5.20E-01	1.75E-06	1.0000	0.4802	4.19E+07	1.04E+03	1.79E+02	6E-08	4.24E-08	1.35E-08
56300	1.74E+01	1.68E-01	1.13E-06	1.0000	0.5252	2.01E+07	1.41E+03	2.20E+02	2E-08	1.36E-08	4.24E-09
72400	7.01E+00	6.79E-02	8.61E-07	1.0000	0.5411	1.06E+07	1.77E+03	2.56E+02	7E-09	5.48E-09	1.67E-09
<i>With 6 MW fire, deposition velocity = 1 cm/s</i>											
100	5.58E-10	0.00E+00	2.62E-19	1.0000	1.0000	2.13E+09	4.51E+00	3.95E+00	6E-15	6.03E-15	0.00E+00
391	3.28E-03	3.28E-05	1.54E-12	1.0000	1.0000	2.13E+09	1.58E+01	1.07E+01	4E-12	2.58E-12	1.33E-12
1900	1.31E+04	1.31E+02	6.24E-06	1.0000	0.9737	2.13E+09	6.46E+01	2.67E+01	1E-05	1.03E-05	4.46E-06
4020	3.27E+04	3.26E+02	1.64E-05	1.0000	0.9176	2.07E+09	1.30E+02	4.48E+01	4E-05	2.57E-05	1.06E-05
5630	2.68E+04	2.67E+02	1.48E-05	1.0000	0.9003	1.90E+09	1.76E+02	5.49E+01	3E-05	2.11E-05	8.39E-06
7240	2.03E+04	2.03E+02	1.25E-05	1.0000	0.8946	1.71E+09	2.21E+02	6.40E+01	2E-05	1.60E-05	6.21E-06
12100	9.30E+03	9.08E+01	7.66E-06	1.0000	0.5835	1.53E+09	3.49E+02	8.59E+01	1E-05	7.29E-06	2.64E-06
24100	2.07E+03	1.96E+01	3.25E-06	1.0000	0.4247	8.95E+08	6.52E+02	1.30E+02	2E-06	1.61E-06	5.32E-07
40200	4.71E+02	4.53E+00	1.65E-06	1.0000	0.5008	3.80E+08	1.04E+03	1.79E+02	5E-07	3.68E-07	1.18E-07
56300	1.62E+02	1.57E+00	1.11E-06	1.0000	0.5324	1.90E+08	1.41E+03	2.20E+02	2E-07	1.27E-07	3.95E-08
72400	6.69E+01	6.49E-01	8.55E-07	1.0000	0.5434	1.01E+08	1.77E+03	2.56E+02	7E-08	5.23E-08	1.60E-08

**OVERALL RISK (LCFs), PLUME CENTERLINE, NO FIRE
STABILITY CLASS F, 1 M/S WIND SPEED**

Dry deposition velocity

Straight-line Wind With Rotation
One Gram WG Pu
Roughness Length = 24 cm
50-Year Exposure
70-Year Commitment

**OVERALL RISK (LCFs), PLUME CENTERLINE, WITH 6 MW FIRE
STABILITY CLASS F, 1 M/S WIND SPEED**

APPENDIX E

RISK COMPUTATIONS FOR POPULATION WITHIN 50 MILES 1990, 1991, and 1992 Meteorological Data

Complementary Cumulative Distribution Functions

One gram WG Pu, 10 minute ground-level release, roughness length = 24 cm
Dry Deposition Velocity = 0.1 cm/s
Wind shift without rotation
50-Year Exposure, 70-Year Commitment

Explanation of column headings:

OVERALL: combined EARLY and CHRONC results

EARLY: results from emergency phase (first week)

CHRONC: results from doses received following emergency phase

LCFs: number of latent cancer fatalities within 50 miles of RFP

PROB > =: probability of exceeding the number of LCFs in column to the left

POPULATION COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTIONS											
TOTAL CANCER FATALITIES (LCFs) WITHIN 50 MILES											
One gram WG Pu, 10 minute release, wind shift without rotation											
Roughness Length = 24 cm, 50-Year Exposure, 70-Year Commitment											
Dry Deposition Velocity = 0.1 cm/s											
OVERALL		EARLY		CHRONC		OVERALL		EARLY		CHRONC	
LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=
Year = 1990, No Fire						Year = 1990, With 6 MW Fire					
1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00
2.00E-05	1.00E+00	2.00E-05	1.00E+00	2.00E-05	9.92E-01	2.00E-05	1.00E+00	2.00E-05	1.00E+00	2.00E-05	9.92E-01
3.00E-05	1.00E+00	3.00E-05	1.00E+00	3.00E-05	9.92E-01	3.00E-05	1.00E+00	3.00E-05	1.00E+00	3.00E-05	9.73E-01
5.00E-05	1.00E+00	5.00E-05	1.00E+00	5.00E-05	9.23E-01	5.00E-05	1.00E+00	5.00E-05	1.00E+00	5.00E-05	8.84E-01
7.00E-05	1.00E+00	7.00E-05	9.92E-01	7.00E-05	9.23E-01	7.00E-05	1.00E+00	7.00E-05	9.92E-01	7.00E-05	8.84E-01
1.00E-04	9.92E-01	1.00E-04	9.92E-01	1.00E-04	8.96E-01	1.00E-04	9.92E-01	1.00E-04	9.92E-01	1.00E-04	8.56E-01
2.00E-04	9.58E-01	2.00E-04	9.15E-01	2.00E-04	8.01E-01	2.00E-04	9.38E-01	2.00E-04	8.75E-01	2.00E-04	7.75E-01
3.00E-04	9.21E-01	3.00E-04	9.15E-01	3.00E-04	7.99E-01	3.00E-04	8.81E-01	3.00E-04	8.75E-01	3.00E-04	7.64E-01
5.00E-04	8.88E-01	5.00E-04	8.69E-01	5.00E-04	7.13E-01	5.00E-04	8.48E-01	5.00E-04	8.30E-01	5.00E-04	6.71E-01
7.00E-04	8.03E-01	7.00E-04	7.98E-01	7.00E-04	6.99E-01	7.00E-04	7.83E-01	7.00E-04	7.69E-01	7.00E-04	6.58E-01
1.00E-03	7.99E-01	1.00E-03	7.92E-01	1.00E-03	6.92E-01	1.00E-03	7.75E-01	1.00E-03	7.65E-01	1.00E-03	6.45E-01
2.00E-03	7.97E-01	2.00E-03	7.04E-01	2.00E-03	4.71E-01	2.00E-03	7.55E-01	2.00E-03	6.62E-01	2.00E-03	4.45E-01
3.00E-03	7.13E-01	3.00E-03	6.74E-01	3.00E-03	3.80E-01	3.00E-03	6.58E-01	3.00E-03	6.34E-01	3.00E-03	3.25E-01
5.00E-03	6.87E-01	5.00E-03	6.33E-01	5.00E-03	2.92E-01	5.00E-03	6.38E-01	5.00E-03	5.80E-01	5.00E-03	2.45E-01
7.00E-03	6.10E-01	7.00E-03	4.61E-01	7.00E-03	2.20E-01	7.00E-03	5.60E-01	7.00E-03	4.35E-01	7.00E-03	1.93E-01
1.00E-02	4.56E-01	1.00E-02	3.69E-01	1.00E-02	1.66E-01	1.00E-02	4.22E-01	1.00E-02	3.12E-01	1.00E-02	1.59E-01
2.00E-02	3.05E-01	2.00E-02	2.59E-01	2.00E-02	5.59E-02	2.00E-02	2.53E-01	2.00E-02	2.14E-01	2.00E-02	5.51E-02
3.00E-02	2.09E-01	3.00E-02	1.72E-01	3.00E-02	3.46E-02	3.00E-02	1.70E-01	3.00E-02	1.34E-01	3.00E-02	3.46E-02
5.00E-02	1.41E-01	5.00E-02	1.17E-01	5.00E-02	8.48E-03	5.00E-02	1.28E-01	5.00E-02	1.09E-01	5.00E-02	8.48E-03
7.00E-02	1.15E-01	7.00E-02	5.57E-02	7.00E-02	4.57E-03	7.00E-02	1.18E-01	7.00E-02	4.83E-02	7.00E-02	4.57E-03
1.00E-01	6.41E-02	1.00E-01	2.94E-02	1.00E-01	3.54E-03	1.00E-01	3.79E-02	1.00E-01	2.94E-02	1.00E-01	3.54E-03
2.00E-01	6.85E-04	2.00E-01	6.85E-04	1.35E-01	2.48E-03	2.00E-01	6.85E-04	2.00E-01	6.85E-04	1.36E-01	2.48E-03
2.51E-01	6.85E-04	2.02E-01	6.85E-04	N.D.	N.D.	2.48E-01	6.85E-04	N.D.	N.D.	N.D.	N.D.

POPULATION COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTIONS											
TOTAL CANCER FATALITIES (LCFs) WITHIN 50 MILES											
One gram WG Pu, 10 minute release, wind shift without rotation											
Roughness Length = 24 cm, 50-Year Exposure, 70-Year Commitment											
Dry Deposition Velocity = 0.1 cm/s											
OVERALL		EARLY		CHRONC		OVERALL		EARLY		CHRONC	
LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=
Year = 1991, No Fire						Year = 1991, With 6 MW Fire					
1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	9.97E-01
2.00E-05	1.00E+00	2.00E-05	1.00E+00	2.00E-05	9.91E-01	2.00E-05	1.00E+00	2.00E-05	9.97E-01	2.00E-05	9.88E-01
3.00E-05	1.00E+00	3.00E-05	1.00E+00	3.00E-05	9.82E-01	3.00E-05	9.97E-01	3.00E-05	9.97E-01	3.00E-05	9.79E-01
5.00E-05	1.00E+00	5.00E-05	1.00E+00	5.00E-05	8.98E-01	5.00E-05	9.97E-01	5.00E-05	9.97E-01	5.00E-05	9.23E-01
7.00E-05	1.00E+00	7.00E-05	1.00E+00	7.00E-05	8.98E-01	7.00E-05	9.97E-01	7.00E-05	9.97E-01	7.00E-05	8.95E-01
1.00E-04	9.91E-01	1.00E-04	9.82E-01	1.00E-04	8.98E-01	1.00E-04	9.88E-01	1.00E-04	9.79E-01	1.00E-04	8.95E-01
2.00E-04	9.54E-01	2.00E-04	9.12E-01	2.00E-04	8.22E-01	2.00E-04	9.51E-01	2.00E-04	9.04E-01	2.00E-04	8.13E-01
3.00E-04	8.98E-01	3.00E-04	8.78E-01	3.00E-04	8.19E-01	3.00E-04	8.95E-01	3.00E-04	8.70E-01	3.00E-04	7.81E-01
5.00E-04	8.90E-01	5.00E-04	8.50E-01	5.00E-04	7.47E-01	5.00E-04	8.87E-01	5.00E-04	7.89E-01	5.00E-04	7.22E-01
7.00E-04	8.13E-01	7.00E-04	8.04E-01	7.00E-04	7.34E-01	7.00E-04	8.00E-01	7.00E-04	7.86E-01	7.00E-04	6.86E-01
1.00E-03	8.07E-01	1.00E-03	8.02E-01	1.00E-03	7.14E-01	1.00E-03	7.94E-01	1.00E-03	7.56E-01	1.00E-03	6.67E-01
2.00E-03	7.94E-01	2.00E-03	7.24E-01	2.00E-03	6.69E-01	2.00E-03	7.51E-01	2.00E-03	6.88E-01	2.00E-03	6.04E-01
3.00E-03	7.34E-01	3.00E-03	7.05E-01	3.00E-03	6.13E-01	3.00E-03	7.05E-01	3.00E-03	6.53E-01	3.00E-03	5.32E-01
5.00E-03	7.03E-01	5.00E-03	6.87E-01	5.00E-03	4.00E-01	5.00E-03	6.58E-01	5.00E-03	6.40E-01	5.00E-03	3.42E-01
7.00E-03	6.91E-01	7.00E-03	6.51E-01	7.00E-03	3.50E-01	7.00E-03	6.49E-01	7.00E-03	5.77E-01	7.00E-03	3.02E-01
1.00E-02	6.48E-01	1.00E-02	6.30E-01	1.00E-02	1.87E-01	1.00E-02	5.83E-01	1.00E-02	5.61E-01	1.00E-02	1.31E-01
2.00E-02	5.30E-01	2.00E-02	3.98E-01	2.00E-02	7.34E-02	2.00E-02	4.70E-01	2.00E-02	3.13E-01	2.00E-02	6.24E-02
3.00E-02	3.82E-01	3.00E-02	3.16E-01	3.00E-02	5.64E-02	3.00E-02	3.03E-01	3.00E-02	2.22E-01	3.00E-02	5.32E-02
5.00E-02	1.70E-01	5.00E-02	1.42E-01	5.00E-02	2.57E-02	5.00E-02	1.25E-01	5.00E-02	8.34E-02	5.00E-02	2.31E-02
7.00E-02	1.52E-01	7.00E-02	1.12E-01	7.00E-02	1.76E-02	7.00E-02	9.33E-02	7.00E-02	3.95E-02	7.00E-02	1.76E-02
1.00E-01	5.71E-02	1.00E-01	2.50E-02	1.00E-01	1.45E-02	1.00E-01	4.29E-02	1.00E-01	2.50E-02	1.00E-01	1.45E-02
2.00E-01	2.19E-02	1.82E-01	1.10E-02	2.00E-01	5.05E-03	2.00E-01	1.92E-02	1.75E-01	1.10E-02	2.00E-01	5.05E-03
3.00E-01	5.05E-03	N.D.	N.D.	2.73E-01	3.05E-03	3.00E-01	5.05E-03	N.D.	N.D.	2.77E-01	3.05E-03
3.25E-01	3.05E-03	N.D.	N.D.	N.D.	N.D.	3.29E-01	3.05E-03	N.D.	N.D.	N.D.	N.D.

POPULATION COMPLEMENTARY CUMULATIVE DISTRIBUTION FUNCTIONS											
TOTAL CANCER FATALITIES (LCFs) WITHIN 50 MILES											
One gram WG Pu, 10 minute release, wind shift without rotation											
Roughness Length = 24 cm, 50-Year Exposure, 70-Year Commitment											
Dry Deposition Velocity = 0.1 cm/s											
OVERALL		EARLY		CHRONC		OVERALL		EARLY		CHRONC	
LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=	LCFs	PROB>=
Year = 1992, No Fire						Year = 1992, With 6 MW Fire					
1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00
2.00E-05	1.00E+00	2.00E-05	1.00E+00	2.00E-05	9.91E-01	2.00E-05	1.00E+00	2.00E-05	1.00E+00	2.00E-05	9.91E-01
3.00E-05	1.00E+00	3.00E-05	1.00E+00	3.00E-05	9.91E-01	3.00E-05	1.00E+00	3.00E-05	1.00E+00	3.00E-05	9.84E-01
5.00E-05	1.00E+00	5.00E-05	1.00E+00	5.00E-05	9.37E-01	5.00E-05	1.00E+00	5.00E-05	1.00E+00	5.00E-05	9.31E-01
7.00E-05	1.00E+00	7.00E-05	1.00E+00	7.00E-05	9.37E-01	7.00E-05	1.00E+00	7.00E-05	9.95E-01	7.00E-05	9.31E-01
1.00E-04	9.91E-01	1.00E-04	9.89E-01	1.00E-04	9.37E-01	1.00E-04	9.91E-01	1.00E-04	9.77E-01	1.00E-04	9.24E-01
2.00E-04	9.81E-01	2.00E-04	9.25E-01	2.00E-04	8.82E-01	2.00E-04	9.75E-01	2.00E-04	9.13E-01	2.00E-04	8.70E-01
3.00E-04	9.32E-01	3.00E-04	9.21E-01	3.00E-04	8.41E-01	3.00E-04	9.20E-01	3.00E-04	9.09E-01	3.00E-04	8.29E-01
5.00E-04	9.30E-01	5.00E-04	8.68E-01	5.00E-04	7.85E-01	5.00E-04	9.11E-01	5.00E-04	8.55E-01	5.00E-04	7.43E-01
7.00E-04	8.79E-01	7.00E-04	8.68E-01	7.00E-04	7.08E-01	7.00E-04	8.67E-01	7.00E-04	8.55E-01	7.00E-04	6.65E-01
1.00E-03	8.74E-01	1.00E-03	8.21E-01	1.00E-03	6.80E-01	1.00E-03	8.62E-01	1.00E-03	8.15E-01	1.00E-03	6.37E-01
2.00E-03	8.19E-01	2.00E-03	7.55E-01	2.00E-03	5.01E-01	2.00E-03	8.00E-01	2.00E-03	7.18E-01	2.00E-03	4.71E-01
3.00E-03	7.05E-01	3.00E-03	6.68E-01	3.00E-03	4.08E-01	3.00E-03	6.54E-01	3.00E-03	6.26E-01	3.00E-03	4.15E-01
5.00E-03	6.85E-01	5.00E-03	6.05E-01	5.00E-03	3.12E-01	5.00E-03	6.40E-01	5.00E-03	5.47E-01	5.00E-03	2.16E-01
7.00E-03	5.62E-01	7.00E-03	4.94E-01	7.00E-03	1.70E-01	7.00E-03	5.14E-01	7.00E-03	4.54E-01	7.00E-03	1.24E-01
1.00E-02	4.80E-01	1.00E-02	4.14E-01	1.00E-02	1.54E-01	1.00E-02	4.50E-01	1.00E-02	4.04E-01	1.00E-02	1.07E-01
2.00E-02	3.53E-01	2.00E-02	3.19E-01	2.00E-02	8.05E-02	2.00E-02	2.79E-01	2.00E-02	1.78E-01	2.00E-02	5.73E-02
3.00E-02	2.41E-01	3.00E-02	1.46E-01	3.00E-02	3.97E-02	3.00E-02	1.57E-01	3.00E-02	8.88E-02	3.00E-02	3.72E-02
5.00E-02	1.37E-01	5.00E-02	7.95E-02	5.00E-02	1.62E-02	5.00E-02	8.52E-02	5.00E-02	4.54E-02	5.00E-02	1.62E-02
7.00E-02	8.90E-02	7.00E-02	6.41E-02	7.00E-02	1.18E-02	7.00E-02	5.51E-02	7.00E-02	3.74E-02	7.00E-02	1.18E-02
1.00E-01	7.11E-02	1.00E-01	5.25E-02	1.00E-01	1.18E-02	1.00E-01	4.26E-02	1.00E-01	1.28E-02	1.00E-01	1.18E-02
2.00E-01	2.20E-02	1.71E-01	1.16E-02	2.00E-01	6.08E-03	2.00E-01	1.84E-02	1.66E-01	1.16E-02	2.00E-01	6.08E-03
3.00E-01	4.14E-03	N.D.	N.D.	3.00E-01	1.20E-03	3.00E-01	4.14E-03	N.D.	N.D.	3.00E-01	1.20E-03
4.51E-01	1.20E-03	N.D.	N.D.	3.06E-01	1.20E-03	4.64E-01	1.20E-03	N.D.	N.D.	3.19E-01	1.20E-03

CCDF of OVERALL Latent Cancer Fatalities in Population to 50 Miles, No Fire

CCDF of OVERALL Latent Cancer Fatalities in Population to 50 Miles, With 6 MW Fire

APPENDIX F

SAMPLE MACCS OUTPUT

1992 Meteorological Data
EPA Method of Calculating Stability Class
Wind Shift Without Rotation

Dry Deposition Velocity = 0.1 cm/s
50 Year Exposure Period
70 Year Commitment Period
Roughness length = 24 cm

Note that the CCDF of χ/Q given in this output differs from that given in Appendix B. The computations presented below use a roughness length of 24 cm whereas the CCDF for Appendix B used 10 cm, as the intention there was to provide values appropriate for MOI calculations. Also, the CCDF given in Appendix B is based on a MACCS2 run that used four starting times (for the 120 hour weather sequences) from each day of the year (1460 starting times for the year) whereas the computations given below used the Monte Carlo sampling technique, which used 102 starting times during the year.

MACCS2 11/24/93 13:13:35 Fixed Noble Gas Omission: Version 1.02, 5/3/93

P1: ATMOS USER INPUT (UNIT 24) = WSNATM.INP
P2: EARLY USER INPUT (UNIT 25) = WSNEAR.INP
P3: CHRONC USER INPUT (UNIT 26) = CHRNEW50.INP
DOSE FACTORS (UNIT 27) = IDCFINH.DAT
P4: METEOROLOGY DATA (UNIT 28) = MET92E.INP
P5: SITE DATA INPUT (UNIT 29) = COLOSIT.INP
P6: LIST OUTPUT (UNIT 06) = WSN92015.OUT

USER INPUT IS READ FROM UNIT 24
RECORD IDENTIFIER FIELDS 11 CHARACTERS LONG ARE EXPECTED.
THE FIRST 100 COLUMNS OF EACH INPUT RECORD ARE PROCESSED.
THE MAXIMUM NUMBER OF IDENTIFIER RECORDS THAT MAY BE SAVED AS THE BASE CASE IS 1000.

RECORD
NUMBER

RECORD

```
*****
*****
* 'ATMOS' USER INPUT FILE FOR POPULATION REFERENCE RUNS - ONE GRAM Pu
*
*   Prepared by:   Vern L. Peterson
*                 Safety Analysis Engineering
*                 EG&G Rocky Flats, Inc.
*
*   Major Input Assumptions/Configuration:
*
*   o Release scenario: one gram Pu released over ten minutes
*   o Real weather data using EPA method of determining stability class
*   o Without wake effects, ground-level releases
*   o Both with and without fire
*   o Wind shift without rotation
*
*****
* RUN IDENTIFICATION (RI) DATA
*
* Descriptive title for this 'ATMOS' user input
*
1 RIATNAM1001 'WSNATM.INP, RFP METEOROLOGICAL DATA, EPA METHOD, NO WAKE EFFECTS'
*
*****
* GEOMETRY (GE) DATA
*
* Number of radial spatial elements
*
2 GENUMRAD001 11
*
* Radii for population distribution from INEL report
* First two radii are included to give central values of 100 and 1900 m.
*
3 GESPAEND001 0.20 0.581 3.219 4.828 6.437 8.047
4 GESPAEND002 16.09 32.19 48.28 64.37 80.47
*
*****
* NUCLIDE (IS) DATA
*
* Number of pseudo-stable nuclides (used to truncate the decay chains)
*
5 ISNUMSTB001 6
*
* List of pseudo-stable nuclides
*
6 ISNAMSTB001 U-234 (daughter of Pu-238)
7 ISNAMSTB002 U-235 (daughter of Pu-239)
8 ISNAMSTB003 U-236 (daughter of Pu-240)
9 ISNAMSTB004 U-237 (daughter of Pu-241)
10 ISNAMSTB005 U-238 (daughter of Pu-242)
```

```

11 ISNAMSTB006  Np-237 (daughter of Am-241)
*
* Number of nuclides considered
*
12 ISNUMISO001   6
*
* Number of nuclide groups
*
13 ISMAXGRP001   2
*
* Wet & dry deposition flags for each nuclide group
*
*           WETDEP   DRYDEP
*
14 ISDEPFLA001   .TRUE.   .TRUE.
15 ISDEPFLA002   .TRUE.   .TRUE.
*
* Nuclide data
*
*           NUCNAM   IGROUP
* Released nuclides (parents)
16 ISOTPGRP001   Pu-238     2
17 ISOTPGRP002   Pu-239     2
18 ISOTPGRP003   Pu-240     2
19 ISOTPGRP004   Pu-241     2
20 ISOTPGRP005   Pu-242     2
21 ISOTPGRP006   Am-241     1
*
*****
* WET DEPOSITION (WD) DATA
*
* Washout coefficient number one, linear factor
* (Ref. Jon Helton after Jones, 1986; used in NUREG-1150, 2nd Draft)
*
22 WDCWASH1001   9.5E-5
*
* Washout coefficient number two, exponential factor
* (Ref. Jon Helton after Jones, 1986; used in NUREG-1150, 2nd Draft)
*
23 WDCWASH2001   0.8
*
*****
* DRY DEPOSITION (DD) DATA
*
* Number of particle size groups
* (for a mean value of about 1E-6 m; Ref. 'Rocky Flats Risk Assessment
* Guide', March 1985, Table 4.2-8
*
24 DDNPSGRP001   1
*
* Deposition velocity of each particle size group (m/s)
*
*DDVDEPOS001   0.01   * 1.0 cm/s (corresponds to 10  $\mu$ m)
25 DDVDEPOS001   0.001 * 0.1 cm/s (corresponds to 1  $\mu$ m)
*
*****
* DISPERSION PARAMETER (DP) DATA
*
* For a given downwind distance X, sigma values are estimated as
* SIGMA = a X ** b with a & b values from TADMOR & GUR (1969);
* used in NUREG-1150, 2nd Draft
*
*
*           A           B           C           D           E           F
26 DPCYSIGA001   .3658   .2751   .2089   .1474   .1046   .0722 (a for sig-y)
27 DPCYSIGB001   .9031   .9031   .9031   .9031   .9031   .9031 (b for sig-y)
28 DPCZSIGA001   2.5E-4   1.9E-3   .2       .3       .4       .2 (a for sig-z)
29 DPCZSIGB001   2.1250   1.6021   .8543   .6532   .6021   .602 (b for sig-z)
*
* Linear scaling factor for SIGMA-Y

```

*
 30 DPYSCALE001 1.
 *
 * Linear scaling factor for SIGMA-Z (normally a surface roughness correction
 * or $\{Z1 / Z0\} ** 0.2$, where $Z0 = 3$ cm; from TRAC database, $Z1 = 24$ cm as
 * avg for the area within 50 miles of RFP. This yields $(24/3)**0.2 = 1.52$.
 *
 31 DPZSCALE001 1.52
 *

 * PLUME MEANDER (PM) DATA
 *
 * Time base for expansion factor (s) (Ref. NUREG-1150, 2nd Draft)
 *
 32 PHTIMBAS001 600. * ten minutes
 *
 * Break point for formula change (s) (Ref. NUREG-1150, 2nd Draft)
 *
 33 PMBRKPNT001 3600. * one hour
 *
 * Exponential expansion factor number 1 (Ref. NUREG-1150, 2nd Draft)
 *
 34 PMXPFAC1001 0.20
 *
 * Exponential expansion factor number 2 (Ref. NUREG-1150, 2nd Draft)
 *
 35 PMXPFAC2001 0.25
 *
 *

 * PLUME RISE (PR) DATA
 *
 * Scaling factor for critical wind speed for trapping a bouyant plume in wake
 * (Ref. NUREG-1150, 2nd Draft)
 *
 36 PRSCLCRW001 1. * do not modify
 *
 * Scaling factor for A-D stability plume rise formula
 * (Ref. NUREG-1150, 2nd Draft)
 *
 37 PRSCLADP001 1. * do not modify
 *
 * Scaling factor for E-F stability plume rise formula
 * (Ref. NUREG-1150, 2nd Draft)
 *
 38 PRSCLEFP001 1. * do not modify
 *

 * WAKE EFFECTS (WE) DATA
 * Minimum values used, to suppress wake effects.
 *
 * Building width (m)
 *
 39 WEBUILDW001 1.0
 *
 * Building height (m)
 *
 40 WEBUILDH001 1.0
 *

 * RELEASE DESCRIPTION (RD) DATA
 *
 * Descriptive title for this release input
 *
 41 RDATNAM2001 '1 g Pu, 10 min, ground-level release, RFP met data, no fire'
 *
 * Time after accident initiation when 'off-site' alarm is issued
 * (since off-site protective actions are not considered, input is
 * unimportant - by setting value to '0', accident initiation & off-site


```

*   alarm are assumed to coincide)
*
42 RDOALARM001  0.
*
*   Number of plume segments that are released
*
43 RDNUMREL001  1
*
*   Identification of risk dominant plume segment
*
44 RDMAXRIS001  1
*
*   Reference point for dispersion & decay of each plume segment
*   (set to leading edge of plume - unimportant since nuclides considered
*   have long half lives with respect to plume duration & wind speed)
*
45 RDREFTIM001  0.
*
*   Rate of heat release for each plume segment (W)
*
46 RDPLHEAT001  0.0 * no fire
*
*   Height of each plume segment at release (m)
*
47 RDPLHITE001  0.0 * ground level
*
*   Release duration of each plume segment (s)
*
48 RDPLUDUR001  600. * ten minutes
*
*   Delay time between accident initiation & release of each plume segment (s)
*
49 RDPDELAY001  0.
*
*   Particle size distribution for deposition velocity 'binning' for each
*   nuclide group
*
50 RDPSDIST001  1.
51 RDPSDIST002  1.
*
*   Process inventory by nuclide (Bq/g generic weapons grade Pu)
*   (Ref. 'Rocky Flats Risk Assessment Guide', March 1985, Table 4.1-1)
*
*   NUCNAM  CORINV (Bq/g generic weapons grade Pu)
*   Released nuclides (parents)
52 RDCORINV001  Pu-238  1.850E+08
53 RDCORINV002  Pu-239  2.131E+09
54 RDCORINV003  Pu-240  4.773E+08
55 RDCORINV004  Pu-241  1.243E+10
56 RDCORINV005  Pu-242  4.440E+04
57 RDCORINV006  Am-241  2.220E+07
*
*   Scaling factor to adjust inventory for release magnitude
*   (in this application, the scaling factor represents
*   the total airborne release of weapons grade Pu in grams)
*   (Standard mass for scaling purposes.)
*
58 RDCORSCA001  1. * one gram release
*
*   Flag to determine whether fractions are applied to the PARENT or to PROGENY
*
59 RDAPLFR001  'PARENT'  same as is hardwired in prior versions
*RDAPLFR001  'PROGENY'
*
*   Release fractions for isotope groups in release
*
*   Isotope Groups
*   1 2
*   Am Pu

```

```

*
60 RDRELFRC001    1.    1.
*
*****
*  OUTPUT CONTROL (OC) DATA
*
*  Flag to control execution; if .TRUE., 'EARLY' & 'CHRONC' inputs are ignored
*
61 OCENDAT1001    .FALSE.  * do the EARLY calculations
*
*  Flag controlling debug output; if 0, debug output is not produced
*  (output is needed to determine ground concentrations)
*
62 OCIDEBUG001    0        * not requested in order to avoid excessive output
*
*  Name of the nuclide to be listed on the dispersion listings
*
63 OCNUCOUT001    Pu-239
*
64 TYPEONUMBER    1
*
*          PLUME  RADIAL-DISTANCE
65 TYPEOOUT001    1      3      CCDF
*
*****
*  METEOROLOGICAL SAMPLING (M1-M5) DATA
*
*  Meteorological sampling option code:
*  METCOD = 1: user-specified start time (day & hr) using 'met' file data
*           2: weather category bin sampling
*           3: 120 hr of weather supplied by user
*           4: constant weather conditions (boundary weather used from start)
*           5: stratified random sampling from each day of the yr
*
66 M1METCOD001    2
*
*  Last radial spatial interval for measured weather
*
67 M2LIMSPA001    11
*
*  Boundary weather mixing layer height (m)
*
68 M2BNDMXH001    1000.  * typical value
*
*  Boundary weather stability class
*
69 M2IBDSTB001    4      * class D, typical value
*
*  Boundary weather rain rate (mm/hr)
*
70 M2BNDRAN001    0.      * most common rain condition
*
*  Boundary weather wind speed (m/s)
*
71 M2BNDWND001    4.0     * typical wind speed
*
*  Number of rain distance intervals for binning
*
72 M4NRNINT001    4
*
*  Endpoints of the rain distance intervals (km)
*
73 M4RNDSTS001    3.2    16.    32.    80.
*
*  Number of rain intensity breakpoints
*
74 M4NRINTN001    2
*
*  Rain intensity breakpoints for weather binning (mm/hr)

```

```

*
75 M4RRATE001 0.5 1.0
*
* Number of samples per bin
*
76 M4NSMPLS001 4
*
* Initial seed for random number generator
*
77 M4IRSEED001 79
*

```

***** TERMINATOR RECORD ENCOUNTERED -- END OF BASE CASE USER INPUT *****

USER INPUT PROCESSING SUMMARY - BASE CASE

```

NUMBER OF RECORDS READ           = 338
NUMBER OF BLANK OR COMMENT RECORDS READ = 260
NUMBER OF TERMINATOR RECORDS     = 1
NUMBER OF RECORDS PROCESSED      = 77
    NUMBER OF PROCESSED RECORDS DUPLICATED = 0
    NUMBER OF PROCESSED RECORDS SORTED   = 77

```

Decay Chain # Pu-238
 Fraction of Pu-238 going to Pu-238 in this chain = 1.00000000

Decay Chain # Pu-239
 Fraction of Pu-239 going to Pu-239 in this chain = 1.00000000

Decay Chain # Pu-240
 Fraction of Pu-240 going to Pu-240 in this chain = 1.00000000

Decay Chain # Pu-241 Am-241
 Fraction of Pu-241 going to Pu-241 in this chain = 1.00000000
 Fraction of Pu-241 going to Am-241 in this chain = 1.00000000
 Fraction of Am-241 going to Am-241 in this chain = 1.00000000

Decay Chain # Pu-242
 Fraction of Pu-242 going to Pu-242 in this chain = 1.00000000

RELEASED INVENTORY OF ALL PLUMES

```

Pu-238 1.85E+08
Pu-239 2.13E+09
Pu-240 4.77E+08
Pu-241 1.24E+10
Pu-242 4.44E+04
Am-241 2.22E+07

```

READING FROM A WEATHER FILE WITH THE FOLLOWING HEADER:

Rocky Flats Plant, Colorado. Jan 1 - Dec 31, 1992

Generated 06/25/93 at 14:07:18.04 using EPA method of calculating stability

METEOROLOGICAL DATA FILE CONTAINS 295 HOURS OF OBSERVED RAIN DATA.

ACCUMULATED RAIN MEASUREMENTS TOTALED 13.90 INCHES FOR THE YEAR.

CONSTANT LID HEIGHTS (M) FOR 4 SEASONS = 1482 3070 3458 2161

NON-ZERO WINDSPEEDS LESS THAN 0.5 M/S ARE SET TO 0.5 M/S

* * * * METEOROLOGICAL BIN SUMMARY * * * *

BIN PRIORITIES

RI XX - RAIN INTENSITY I WITHIN THE INTERVAL ENDING AT XX

		INTERVAL ENDPOINTS ARE IN KILOMETERS FROM THE ACCIDENT SITE, THE 4 INTERVAL ENDPOINTS ARE																3	16	32	80	
		RAIN INTENSITIES ARE IN MILLIMETERS OF RAIN PER HOUR, THE 2 INTENSITY BREAKPOINTS ARE																0.5	1.0			
1	B	3	0.042	0.020	0.019	0.017	0.015	0.019	0.016	0.032	0.046	0.086	0.088	0.104	0.118	0.186	0.129	0.064	1017	11.6096		
2	B	4	0.015	0.027	0.006	0.012	0.027	0.018	0.045	0.027	0.045	0.130	0.115	0.100	0.048	0.154	0.154	0.076	331	3.7785		
3	D	1	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1	0.0114		
4	D	2	0.061	0.061	0.101	0.066	0.127	0.066	0.083	0.096	0.061	0.061	0.031	0.035	0.013	0.035	0.057	0.044	228	2.6027		
5	D	3	0.071	0.068	0.067	0.065	0.118	0.092	0.095	0.079	0.096	0.032	0.027	0.021	0.016	0.026	0.065	0.062	812	9.2694		
6	D	4	0.077	0.059	0.076	0.077	0.085	0.091	0.089	0.101	0.087	0.055	0.031	0.019	0.012	0.024	0.041	0.076	1534	17.5114		
7	D	5	0.031	0.021	0.057	0.100	0.110	0.243	0.137	0.083	0.082	0.046	0.017	0.005	0.004	0.000	0.024	0.039	839	9.5776		
8	D	6	0.004	0.001	0.007	0.049	0.223	0.471	0.143	0.030	0.029	0.021	0.014	0.000	0.000	0.000	0.000	0.006	698	7.9680		
9	E	1	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	1	0.0114		
10	E	2	0.032	0.059	0.074	0.106	0.138	0.149	0.101	0.101	0.053	0.048	0.037	0.021	0.016	0.011	0.021	0.032	188	2.1461		
11	E	3	0.066	0.084	0.073	0.112	0.138	0.136	0.103	0.059	0.053	0.020	0.020	0.007	0.011	0.007	0.086	0.026	455	5.1941		
12	E	4	0.054	0.102	0.161	0.226	0.072	0.052	0.090	0.128	0.050	0.015	0.006	0.005	0.003	0.004	0.006	0.026	796	9.0868		
13	F	1	0.000	0.000	0.250	0.000	0.000	0.250	0.000	0.000	0.250	0.000	0.250	0.000	0.000	0.000	0.000	0.000	4	0.0457		
14	F	2	0.063	0.052	0.095	0.095	0.112	0.101	0.103	0.071	0.063	0.045	0.032	0.034	0.024	0.047	0.026	0.037	464	5.2968		
15	F	3	0.059	0.071	0.121	0.126	0.111	0.086	0.094	0.086	0.049	0.034	0.020	0.012	0.025	0.027	0.030	0.049	406	4.6347		
17	R1	3	0.032	0.000	0.048	0.016	0.016	0.032	0.063	0.119	0.270	0.151	0.087	0.032	0.032	0.016	0.032	0.056	126	1.4384		
18	R1	16	0.029	0.015	0.015	0.059	0.029	0.044	0.029	0.059	0.147	0.132	0.118	0.118	0.044	0.059	0.015	0.088	68	0.7763		
19	R1	32	0.000	0.024	0.012	0.024	0.000	0.071	0.129	0.106	0.118	0.118	0.094	0.059	0.047	0.071	0.059	0.071	85	0.9703		
20	R1	80	0.037	0.027	0.005	0.048	0.069	0.043	0.101	0.112	0.133	0.117	0.043	0.053	0.059	0.048	0.064	0.043	188	2.1461		
21	R2	3	0.015	0.015	0.000	0.015	0.076	0.045	0.045	0.121	0.258	0.212	0.061	0.015	0.030	0.030	0.000	0.061	66	0.7534		
22	R2	16	0.097	0.032	0.000	0.032	0.032	0.032	0.032	0.161	0.065	0.258	0.032	0.000	0.032	0.097	0.065	0.032	31	0.3539		
23	R2	32	0.000	0.024	0.000	0.000	0.000	0.048	0.048	0.071	0.214	0.167	0.071	0.143	0.000	0.095	0.048	0.071	42	0.4795		
24	R2	80	0.043	0.022	0.011	0.000	0.011	0.011	0.022	0.118	0.118	0.183	0.086	0.086	0.108	0.075	0.075	0.032	93	1.0616		
25	R3	3	0.039	0.010	0.019	0.019	0.058	0.039	0.107	0.204	0.204	0.136	0.039	0.029	0.058	0.010	0.010	0.019	103	1.1758		
26	R3	16	0.000	0.000	0.038	0.038	0.038	0.000	0.154	0.192	0.000	0.154	0.231	0.038	0.077	0.000	0.000	0.038	26	0.2968		
27	R3	32	0.064	0.021	0.000	0.021	0.000	0.064	0.021	0.106	0.106	0.106	0.149	0.128	0.106	0.021	0.085	0.000	47	0.5365		
28	R3	80	0.027	0.018	0.009	0.009	0.009	0.045	0.045	0.063	0.099	0.198	0.081	0.045	0.045	0.090	0.072	0.144	111	1.2671		
29	ALL		0.049	0.047	0.063	0.079	0.092	0.119	0.088	0.080	0.075	0.060	0.040	0.033	0.029	0.045	0.051	0.050	8760			

* * * * METEOROLOGICAL BIN SUMMARY * * * *

BIN PRIORITIES

RI XX - RAIN INTENSITY I WITHIN THE INTERVAL ENDING AT XX

INTERVAL ENDPOINTS ARE IN KILOMETERS FROM THE ACCIDENT SITE, THE 4 INTERVAL ENDPOINTS ARE
RAIN INTENSITIES ARE IN MILLIMETERS OF RAIN PER HOUR, THE 2 INTENSITY BREAKPOINTS ARE

3 16 32 80
0.5 1.0

1 B	3	43	20	19	17	15	19	16	33	47	87	90	106	120	189	131	65	1017	11.6096
2 B	4	5	9	2	4	9	6	15	9	15	43	38	33	16	51	51	25	331	3.7785
3 D	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0.0114
4 D	2	14	14	23	15	29	15	19	22	14	14	7	8	3	8	13	10	228	2.6027
5 D	3	58	55	54	53	96	75	77	64	78	26	22	17	13	21	53	50	812	9.2694
6 D	4	118	91	117	118	130	139	137	155	133	84	48	29	18	37	63	117	1534	17.5114
7 D	5	26	18	48	84	92	204	115	70	69	39	14	4	3	0	20	33	839	9.5776
8 D	6	3	1	5	34	156	329	100	21	20	15	10	0	0	0	0	4	698	7.9680
9 E	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0.0114
10 E	2	6	11	14	20	26	28	19	19	10	9	7	4	3	2	4	6	188	2.1461
11 E	3	30	38	33	51	63	62	47	27	24	9	9	3	5	3	39	12	455	5.1941
12 E	4	43	81	128	180	57	41	72	102	40	12	5	4	2	3	5	21	796	9.0868
13 F	1	0	0	1	0	0	1	0	0	1	0	1	0	0	0	0	0	4	0.0457
14 F	2	29	24	44	44	52	47	48	33	29	21	15	16	11	22	12	17	464	5.2968
15 F	3	24	29	49	51	45	35	38	35	20	14	8	5	10	11	12	20	406	4.6347
16 F	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0000
17 R1	3	4	0	6	2	2	4	8	15	34	19	11	4	4	2	4	7	126	1.4384
18 R1	16	2	1	1	4	2	3	2	4	10	9	8	8	3	4	1	6	68	0.7763
19 R1	32	0	2	1	2	0	6	11	9	10	10	8	5	4	6	5	6	85	0.9703
20 R1	80	7	5	1	9	13	8	19	21	25	22	8	10	11	9	12	8	188	2.1461
21 R2	3	1	1	0	1	5	3	3	8	17	14	4	1	2	2	0	4	66	0.7534
22 R2	16	3	1	0	1	1	1	1	5	2	8	1	0	1	3	2	1	31	0.3539
23 R2	32	0	1	0	0	0	2	2	3	9	7	3	6	0	4	2	3	42	0.4795
24 R2	80	4	2	1	0	1	1	2	11	11	17	8	8	10	7	7	3	93	1.0616
25 R3	3	4	1	2	2	6	4	11	21	21	14	4	3	6	1	1	2	103	1.1758
26 R3	16	0	0	1	1	1	0	4	5	0	4	6	1	2	0	0	1	26	0.2968
27 R3	32	3	1	0	1	0	3	1	5	5	5	7	6	5	1	4	0	47	0.5365
28 R3	80	3	2	1	1	1	5	5	7	11	22	9	5	5	10	8	16	111	1.2671

* * * * SUMMARIES * * * *

R	31	17	14	24	32	40	69	114	155	151	77	57	53	49	46	57	986	11.2557
B	48	29	21	21	24	25	31	42	62	130	128	139	136	240	182	90	1348	15.3881
D	219	179	248	304	503	762	448	332	314	178	101	58	37	66	149	214	4112	46.9406
E	79	130	175	251	146	131	138	148	74	31	21	11	10	8	48	39	1440	16.4384
F	53	53	94	95	97	83	86	68	50	35	24	21	21	33	24	37	874	9.9772
1	0	0	2	0	0	1	0	1	1	1	1	0	0	0	0	0	7	0.0799
2	71	58	93	87	116	100	92	96	74	73	57	60	64	84	58	55	1238	14.1324
3	133	133	143	164	210	181	172	136	148	107	101	99	101	172	206	125	2331	26.6096
4	166	181	244	298	196	186	223	265	188	137	91	66	36	91	119	163	2650	30.2511
5	26	18	51	88	92	204	116	71	69	41	14	4	3	0	20	33	850	9.7032
6	3	1	5	34	156	329	100	21	20	15	10	0	0	0	0	4	698	7.9680

*** BIN WINDROSE SUMMARY ***

BIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	TOTAL
1	0.042	0.020	0.019	0.017	0.015	0.019	0.016	0.032	0.046	0.086	0.088	0.104	0.118	0.186	0.129	0.064	1.000000
2	0.015	0.027	0.006	0.012	0.027	0.018	0.045	0.027	0.045	0.130	0.115	0.100	0.048	0.154	0.154	0.076	1.000000
3	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000000
4	0.061	0.061	0.101	0.066	0.127	0.066	0.083	0.096	0.061	0.061	0.031	0.035	0.013	0.035	0.057	0.044	1.000000
5	0.071	0.068	0.067	0.065	0.118	0.092	0.095	0.079	0.096	0.032	0.027	0.021	0.016	0.026	0.065	0.062	1.000000
6	0.077	0.059	0.076	0.077	0.085	0.091	0.089	0.101	0.087	0.055	0.031	0.019	0.012	0.024	0.061	0.076	1.000000
7	0.031	0.021	0.057	0.100	0.110	0.243	0.137	0.083	0.082	0.046	0.017	0.005	0.004	0.000	0.024	0.039	1.000000
8	0.004	0.001	0.007	0.049	0.223	0.471	0.143	0.030	0.029	0.021	0.014	0.000	0.000	0.000	0.000	0.006	1.000000
9	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000000
10	0.032	0.059	0.074	0.106	0.138	0.149	0.101	0.101	0.053	0.048	0.037	0.021	0.016	0.011	0.021	0.032	1.000000
11	0.066	0.084	0.073	0.112	0.138	0.136	0.103	0.059	0.050	0.015	0.020	0.007	0.011	0.007	0.086	0.026	1.000000
12	0.054	0.102	0.161	0.226	0.072	0.052	0.090	0.128	0.050	0.015	0.006	0.005	0.003	0.004	0.006	0.026	1.000000
13	0.000	0.000	0.250	0.000	0.000	0.250	0.000	0.000	0.250	0.000	0.250	0.000	0.000	0.000	0.000	0.000	1.000000
14	0.063	0.052	0.095	0.095	0.112	0.101	0.103	0.071	0.063	0.045	0.032	0.034	0.024	0.047	0.026	0.037	1.000000
15	0.059	0.071	0.121	0.126	0.111	0.086	0.094	0.086	0.049	0.034	0.020	0.012	0.025	0.027	0.030	0.049	1.000000
16	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.000000
17	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
18	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
19	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
20	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
21	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
22	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
23	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
24	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
25	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
26	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
27	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
28	0.031	0.017	0.014	0.024	0.032	0.041	0.070	0.116	0.157	0.153	0.078	0.058	0.054	0.050	0.047	0.058	1.000000
29	0.049	0.047	0.063	0.079	0.092	0.119	0.088	0.080	0.075	0.060	0.040	0.033	0.029	0.045	0.051	0.050	1.000000

```

***** BEGINNING OF CHANGE CASE 1 USER INPUT *****
*****
* SUBSTITUTION DATA FOR ADDITIONAL RUNS
*
* CHANGE 1
*
* RELEASE DESCRIPTION (RD) DATA
*
* Descriptive title for this release input
*
78 RDATNAM2001 '1 g Pu, 10 min, ground-level release, RFP met data, with fire'
***** RECORD NUMBER 78 REPLACES RECORD NUMBER 41 *****
*
* Rate of heat release for each plume segment (W)
*
79 RDPLHEAT001 6.0E+6 * Generic fire
***** RECORD NUMBER 79 REPLACES RECORD NUMBER 46 *****
*
*****
* END OF 'ATMOS' USER INPUT FILE

```

```

***** TERMINATOR RECORD ENCOUNTERED -- END OF CHANGE CASE 1 USER INPUT *****

```

```

USER INPUT PROCESSING SUMMARY - CHANGE CASE 1
NUMBER OF RECORDS CHANGED      = 2
NUMBER OF RECORDS ADDED        = 0
*****

```

RELEASED INVENTORY OF ALL PLUMES

Pu-238	1.85E+08
Pu-239	2.13E+09
Pu-240	4.77E+08
Pu-241	1.24E+10
Pu-242	4.44E+04
Am-241	2.22E+07

USER INPUT IS READ FROM UNIT 25
 RECORD IDENTIFIER FIELDS 11 CHARACTERS LONG ARE EXPECTED.
 THE FIRST 100 COLUMNS OF EACH INPUT RECORD ARE PROCESSED.
 THE MAXIMUM NUMBER OF IDENTIFIER RECORDS THAT MAY BE SAVED AS THE BASE CASE IS 1000.

RECORD
 NUMBER

RECORD

```

*****
* 'EARLY' USER INPUT FILE FOR POPULATION REFERENCE RUNS, ONE GRAM Pu
*
*   Prepared by: Vern L. Peterson
*               Safety Analysis Engineering
*               EG&G Rocky Flats, Inc.
*
*   Major Input Assumptions/Configurations:
*
*   o Population (POP) calculations
*   o Wind-shift without rotation
*   o Site file used
*   o No evacuation or sheltering
*
*****
* GENERAL DESCRIPTIVE TITLE DESCRIBING THIS "EARLY" INPUT FILE
*
1 MIEANAM1001 'WSNEAR.INP, WIND-SHIFT WITHOUT ROTATION, 50-MILE POPULATION'
*
*****
* ORGAN DEFINITION LIST
*
*           ORGNAM           ORGFLG
*
2 MIORGDEF001 'A-SKIN'       .TRUE.
3 MIORGDEF002 'A-RED MARR'   .TRUE.
4 MIORGDEF003 'A-LUNGS'     .TRUE.
5 MIORGDEF004 'A-THYROIDH'   .FALSE.
6 MIORGDEF005 'A-STOMACH'    .TRUE.
7 MIORGDEF006 'A-LOWER LI'   .TRUE.
8 MIORGDEF007 'L-EDEWBODY'   .TRUE.
9 MIORGDEF008 'L-RED MARR'   .TRUE.
10 MIORGDEF009 'L-BONE SUR'   .TRUE.
11 MIORGDEF010 'L-BREAST'    .TRUE.
12 MIORGDEF011 'L-LUNGS'     .TRUE.
13 MIORGDEF012 'L-THYROID'   .TRUE.
14 MIORGDEF013 'L-LOWER LI'   .TRUE.
15 MIORGDEF014 'L-BLADDER'    .TRUE.
16 MIORGDEF015 'L-LIVER'     .TRUE.
17 MIORGDEF016 'L-THYROIDH'   .FALSE.
*
*****
* FLAG TO INDICATE THAT THIS IS THE LAST PROGRAM IN THE SERIES TO BE RUN
*
18 MIENDAT2001 .FALSE.      * SET THIS VALUE TO .TRUE. TO SKIP CHRONC
*
* DISPERSION MODEL OPTION CODE:  1 * STRAIGHT LINE WITH ROTATION
*                               2 * WIND-SHIFT WITH ROTATION
*                               3 * WIND-SHIFT WITHOUT ROTATION
*
19 MIIPLUME001 3
*
*   NUMBER OF FINE GRID SUBDIVISIONS USED BY THE MODEL
*
20 MINUMFIN001 7      * 3, 5 OR 7 ALLOWED
*
*   LEVEL OF DEBUG OUTPUT REQUIRED, NORMAL RUNS SHOULD SPECIFY ZERO
*
21 MIIPRINT001 0
  
```



```

*
* LOGICAL FLAG SIGNIFYING THAT THE BREAKDOWN OF RISK BY WEATHER CATEGORY
* BIN ARE TO BE PRESENTED TO SHOW THEIR RELATIVE CONTRIBUTION TO THE MEAN
*
*           RISBIN
*
22 MIRISCAT001 .FALSE.
*
* FLAG INDICATING IF WIND-ROSES FROM ATMOS ARE TO BE OVERRIDDEN
*
23 MIOVRRID001 .FALSE.
*
*****
* POPULATION DISTRIBUTION DATA BLOCK, LOADED BY INPOPU, STORED IN /POPDAT/
*
* POPULATION DISTRIBUTION FLAG, EITHER 'UNIFORM' OR 'FILE'
*
24 PDPOPFLG001 FILE
*
*****
* SHIELDING AND EXPOSURE FACTORS, LOADED BY INDFAC, STORED IN /EADFAC/
*
* THREE VALUES OF EACH PROTECTION FACTOR ARE SUPPLIED,
* ONE FOR EACH TYPE OF ACTIVITY:
*
* ACTIVITY TYPE:
*   1 - EVACUEES WHILE MOVING
*   2 - NORMAL ACTIVITY IN SHELTERING AND EVACUATION ZONE
*   3 - SHELTERED ACTIVITY
*
*           EVACUEES  NORMAL  SHELTERED
*
* CLOUD SHIELDING FACTORS
*
25 SECSFACT001      1.00    0.75    0.60  * FROM MACCS DOCUMENTATION
*
* PROTECTION FACTOR FOR INHALATION
*
26 SEPROTIN001      1.00    0.41    0.33  * FROM MACCS DOCUMENTATION
*
* BREATHING RATE (CUBIC METERS PER SECOND)
*
27 SEBRRATE001  3.47E-4  3.33E-4  2.66E-4  * HEAVY, MODERATE, AND LIGHT ACTIVITY
*
* SKIN PROTECTION FACTOR
*
28 SESKPFAC001      1.00    0.41    0.33  * FROM MACCS DOCUMENTATION
*
* GROUND SHIELDING FACTOR
*
29 SEGSHFAC001      0.50    0.33    0.20  * FROM MACCS DOCUMENTATION
*
* RESUSPENSION INHALATION MODEL CONCENTRATION COEFFICIENT (/METER)
*
*   RESCON = 1.E-4 IS APPROPRIATE FOR MECHANICAL RESUSPENSION BY VEHICLES.
*   RESHAF = 2.11 DAYS CAUSES 1.E-4 TO DECAY IN ONE WEEK TO 1.E-5, THE VALUE
*   OF RESCON USED IN THE FIRST TERM OF THE LONG-TERM RESUSPENSION EQUATION
*   USED IN CHRONC.
*
30 SERESCON001      1.E-4    * FROM MACCS DOCUMENTATION
*
* RESUSPENSION CONCENTRATION COEFFICIENT HALF-LIFE (SEC)
*
31 SERESHAF001      1.825E5  * 2.11 DAYS, FROM MACCS DOCUMENTATION
*
*****
* EVACUATION ZONE DATA BLOCK, LOADED BY EVNETW, STORED IN /NETWOR/, /EOPTIO/
*
* SPECIFIC DESCRIPTION OF THE EMERGENCY RESPONSE SCENARIO BEING USED

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```

*
32 EZEANAM2001 'NO EVACUATION'
*
* THE TYPE OF WEIGHTING TO BE APPLIED TO THE EMERGENCY RESPONSE SCENARIOS
* THE VALUE IS EITHER 'TIME' OR 'PEOPLE'
*
33 EZWTNAME001 'PEOPLE'
*
* WEIGHTING FRACTION APPLICABLE TO THIS SCENARIO
*
34 EZWTFRAC001 1.00 * ALL THE PEOPLE
*
* LAST RING IN THE MOVEMENT ZONE
*
35 EZLASM0V001 0 * NO EVACUATION
*
*****
* SHELTER AND RELOCATION ZONE DATA BLOCK, LOADED BY INPEMR,
* STORED IN /INPSRZ/, /RELOCA/
*
* DURATION OF THE EMERGENCY PHASE (SECONDS FROM PLUME ARRIVAL)
*
36 SRENDEMP001 604800. * ONE WEEK
*
* CRITICAL ORGAN FOR RELOCATION DECISIONS
*
37 SRCRIORG001 'L-EDEWBODY'
*
* HOT SPOT RELOCATION TIME (SECONDS FROM PLUME ARRIVAL)
*
38 SRTIMHOT001 604800. * MAXIMUM VALUE, AS RELOCATION NOT CONSIDERED
*
* NORMAL RELOCATION TIME (SECONDS FROM PLUME ARRIVAL)
*
39 SRTIMNRM001 604800. * MAXIMUM VALUE, AS RELOCATION NOT CONSIDERED
*
* HOT SPOT RELOCATION DOSE CRITERION THRESHOLD (SIEVERTS)
*
40 SRDOSH0T001 100. * MAXIMUM VALUE TO PREVENT RELOCATION
*
* NORMAL RELOCATION DOSE CRITERION THRESHOLD (SIEVERTS)
*
41 SRDOSNRM001 100. * MAXIMUM VALUE TO PREVENT RELOCATION
*
*****
* EARLY FATALITY MODEL PARAMETERS, LOADED BY INEFAT, STORED IN /EFATAL/
*
* NUMBER OF EARLY FATALITY EFFECTS
*
42 EFNUMEFA001 3
*
* ORGNAM EFFACA EFFACB EFFTHR VALUES FROM MACCS DOCS
*
43 EFATAGRP001 'A-RED MARR' 3.8 5.0 1.5
44 EFATAGRP002 'A-LUNGS' 10.0 7.0 5.0
45 EFATAGRP003 'A-LOWER LI' 15.0 10.0 8.0
*
*****
* EARLY INJURY MODEL PARAMETERS, LOADED BY INEINJ, STORED IN /EINJUR/
*
* NUMBER OF EARLY INJURY EFFECTS
*
46 EINUMEIN001 5
*
* EINAME ORGNAM EISUSC EITHRE EIFACA EIFACB MACCS DOCS
*
47 EINJUGRP001 'PRODROMAL VOMIT' 'A-STOMACH' 1. .5 2. 3.
48 EINJUGRP002 'DIARRHEA' 'A-STOMACH' 1. 1. 3. 2.5
49 EINJUGRP003 'PNEUMONITIS' 'A-LUNGS' 1. 5. 10. 7.

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50 EINJUGRP004 'SKIN ERYTHEMA' 'A-SKIN' 1. 3. 6. 5.
51 EINJUGRP005 'TRANSEPIDERMAL' 'A-SKIN' 1. 10. 20. 5.
*
*****
* ACUTE EXPOSURE CANCER PARAMETERS, LOADED BY INACAN STORED IN /ACANCR/.
*
* NUMBER OF ACUTE EXPOSURE CANCER EFFECTS
*
52 LCNUMACA001 3
*
* THRESHOLD DOSE FOR APPLYING THE DOSE DEPENDENT REDUCTION FACTOR
*
53 LCDDTHRE001 0.2 (LOWEST DOSE FOR WHICH DDREFA WILL BE APPLIED)
*
* DOSE THRESHOLD FOR LINEAR DOSE RESPONSE (SV)
*
54 LCACTHRE001 0.0 (LINEAR-QUADRATIC MODEL IS NOT BEING USED)
*
*
* ACNAME ORGNAM ACSUSC DOSEFA DOSEFB CFRISK CIRISK DDREFA
*
55 LCANCERS001 'BONE' 'L-BONE SUR' 1.0 1.0 0.0 6.00E-5 6.00E-5 1.0
56 LCANCERS002 'LUNG' 'L-LUNGS' 1.0 1.0 0.0 8.00E-3 8.00E-3 1.0
57 LCANCERS003 'LIVER' 'L-LIVER' 1.0 1.0 0.0 1.50E-3 1.50E-3 1.0
*
* THE ABOVE VALUES ARE BASED ON THE RECOMMENDATIONS OF BOBBY SCOTT, OF DOE'S
* INHALATION TOXICOLOGY RESEARCH INSTITUTE (ITRI). THESE ARE ALSO IN
* NUREG/CR-4214, Rev 1, Part II, Addendum 2. THE VALUES ARE:
* bone skeleton risk = (12 cancers/10^4 person Gray)/(20 Sv/Gray) = 6E-5/Sv
* lung risk = (1600 cancers/10^4 person Gray)/(20 Sv/Gray) = 8.0E-3/Sv
* liver risk = (300 cancers/10^4 person Gray)/(20 Sv/Gray) = 1.5E-3/Sv
*
*****
* RESULT 1 OPTIONS BLOCK, LOADED BY INOUT1, STORED IN /INOUT1/
* TOTAL NUMBER OF A GIVEN EFFECT (LATENT CANCER, EARLY DEATH, EARLY INJURY)
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
58 TYPE1NUMBER 4
*
59 TYPE1OUT001 'CAN FAT/TOTAL' 1 11 CCDF * (0 - 50 MILES)
60 TYPE1OUT002 'CAN FAT/BONE' 1 11 * (0 - 50 MILES)
61 TYPE1OUT003 'CAN FAT/LUNG' 1 11 * (0 - 50 MILES)
62 TYPE1OUT004 'CAN FAT/LIVER' 1 11 * (0 - 50 MILES)
*
*****
* RESULT 2 OPTIONS BLOCK, LOADED BY INOUT2, STORED IN /INOUT2/
* FURTHEST DISTANCE AT WHICH A GIVEN RISK OF EARLY DEATH IS EXCEEDED.
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
63 TYPE2NUMBER 1
*
* FATALITY RISK THRESHOLD
*
64 TYPE2OUT001 0.0 * Distance at which any fatalities occur
*
*****
* RESULT 3 OPTIONS BLOCK, LOADED BY INOUT3, STORED IN /INOUT3/
* NUMBER OF PEOPLE WHOSE DOSE TO A GIVEN ORGAN EXCEEDS A GIVEN THRESHOLD.
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
65 TYPE3NUMBER 1
*
* ORGAN NAME DOSE THRESHOLD (SV) DOSE FLAG
*
66 TYPE3OUT001 'L-EDEWBODY' 0.05 LIFETIME
*
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* RESULT 4 OPTIONS BLOCK, LOADED BY INOUT4, STORED IN /INOUT4/
* 360 DEGREE AVERAGE RISK OF A GIVEN EFFECT AT A GIVEN DISTANCE.
*
* POSSIBLE TYPES OF EFFECTS ARE:
*
*   'ERL FAT/TOTAL'
*   'ERL INJ/INJURY NAME'
*   'CAN FAT/CANCER NAME'
*   'CAN FAT/TOTAL'
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
67 TYPE4NUMBER 2
*
*           RADIAL INDEX   TYPE OF EFFECT
*
68 TYPE4OUT001      3       'CAN FAT/TOTAL'
69 TYPE4OUT002      3       'ERL FAT/TOTAL'
*
*****
* RESULT 5 OPTIONS BLOCK, LOADED BY INOUT5, STORED IN /INOUT5/
*
* TOTAL POPULATION DOSE TO A GIVEN ORGAN BETWEEN TWO DISTANCES.
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
70 TYPE5NUMBER      4
*
*           ORGAN          I1DIS5    I2DIS5
*
71 TYPE5OUT001 'L-EDEWBODY'  1         11  CCDF (0 - 50 MILES)
72 TYPE5OUT002 'L-BONE SUR'  1         11  (0 - 50 MILES)
73 TYPE5OUT003 'L-LUNGS'    1         11  (0 - 50 MILES)
74 TYPE5OUT004 'L-LIVER'    1         11  (0 - 50 MILES)
*
*****
* RESULT 6 OPTIONS BLOCK, LOADED BY INOUT6, STORED IN /INOUT6/
* CENTERLINE DOSE TO AN ORGAN VS DIST BY PATHWAY, PATHWAY NAMES ARE AS FOLLOWS:
* Valid only if IPLUME = 1
* PATHWAY NAME:
*   'CLD' - CLOUDSHINE
*   'GRD' - GROUNDSHINE
*   'INH ACU' - "ACUTE DOSE EQUIVALENT" FROM DIRECT INHALATION OF THE CLOUD
*   'INH LIF' - "LIFETIME DOSE COMMITMENT" FROM DIRECT INHALATION OF THE CLOUD
*   'RES ACU' - "ACUTE DOSE EQUIVALENT" FROM RESUSPENSION INHALATION
*   'RES LIF' - "LIFETIME DOSE COMMITMENT" FROM RESUSPENSION INHALATION
*   'TOT ACU' - "ACUTE DOSE EQUIVALENT" FROM ALL PATHWAYS
*   'TOT LIF' - "LIFETIME DOSE COMMITMENT" FROM ALL PATHWAYS
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
75 TYPE6NUMBER      0
*
*           ORGNAM          PATHNM     I1DIS6    I2DIS6
*
*TYPE6OUT001 'L-EDEWBODY' 'TOT LIF'  1         11  (0 - 50 MILES)
*TYPE6OUT002 'L-EDEWBODY' 'INH LIF'  1         11  (0 - 50 MILES)
*TYPE6OUT003 'L-EDEWBODY' 'RES LIF'  1         11  (0 - 50 MILES)
*
*****
* RESULT 7 OPTIONS BLOCK, LOADED BY INOUT7, STORED IN /INOUT7/
* valid only if IPLUME = 1
* CENTERLINE RISK OF A GIVEN EFFECT VS DISTANCE
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
76 TYPE7NUMBER      0
*
*           NAME              I1DIS7    I2DIS7

```

```

*
*TYPE8OUT001 'CAN FAT/TOTAL'      1      11      (0 - 50 MILES)
*
*****
* RESULT 8 OPTIONS BLOCK, LOADED BY INOUT8, STORED IN /INOUT8/
*
* POPULATION WEIGHTED FATALITY RISK BETWEEN 2 DISTANCES
*
* NUMBER OF DESIRED RESULTS OF THIS TYPE
*
77 TYPE8NUMBER 5
*
*          NAME          11DIS8 12DIS8
*
78 TYPE8OUT001 'CAN FAT/TOTAL'    1      11      (0 - 50 MILES)
79 TYPE8OUT002 'CAN FAT/TOTAL'    3      3      (PLANT BOUNDARY)
80 TYPE8OUT003 'CAN FAT/BONE'     3      3      (PLANT BOUNDARY)
81 TYPE8OUT004 'CAN FAT/LUNG'     3      3      (PLANT BOUNDARY)
82 TYPE8OUT005 'CAN FAT/LIVER'    3      3      (PLANT BOUNDARY)
*
*****
* RESULT A OPTIONS BLOCK, LOADED BY INOUTA, STORED IN /INOUTA/
*
* Peak dose to a given organ
*
*          NUMA
83 TYPEANUMBER 4
*
*          ORGNAM          11DISA 12DISA
84 TYPEAOUT001 'L-EDEWBODY'      1      11      (0 - 50 MILES)
85 TYPEAOUT002 'L-BONE SUR'      1      11      (0 - 50 MILES)
86 TYPEAOUT003 'L-LUNGS'        1      11      (0 - 50 MILES)
87 TYPEAOUT004 'L-LIVER'        1      11      (0 - 50 MILES)
*
*****
* END OF 'EARLY' INPUT
*****
***** TERMINATOR RECORD ENCOUNTERED -- END OF BASE CASE USER INPUT *****

```

USER INPUT PROCESSING SUMMARY - BASE CASE

```

NUMBER OF RECORDS READ              = 374
NUMBER OF BLANK OR COMMENT RECORDS READ = 286
NUMBER OF TERMINATOR RECORDS        = 1
NUMBER OF RECORDS PROCESSED          = 87
NUMBER OF PROCESSED RECORDS DUPLICATED = 0
NUMBER OF PROCESSED RECORDS SORTED   = 87
*****

```

The list of defined organs is as follows(A is ACUTE and L is LIFETIME):

```

A-SKIN
A-RED MARR
A-LUNGS
A-STOMACH
A-LOWER LI
L-EDEWBODY
L-RED MARR
L-BONE SUR
L-BREAST
L-LUNGS
L-THYROID
L-LOWER LI
L-BLADDER
L-LIVER
NO EVACUATION REQUESTED

```

USING THE FOLLOWING SITE DATA FILE:

MACCS SITE DATA FILE FOR ROCKY FLATS PLANT OUT TO 50 MILES

GENERIC WG Pu

11 SPATIAL INTERVALS

16 WIND DIRECTIONS

7 CROP CATEGORIES

2 WATER PATHWAY ISOTOPES

2 WATERSHEDS

3 ECONOMIC REGIONS

SPATIAL DISTANCES

(first and third ranges centered at 100 and 1900 m)

0.2 0.581 3.219 4.828 6.437 8.047 16.09 32.19

48.28 64.37 80.47

POPULATION

(1991 estimates based on 1980 census data)

0. 0. 0. 0. 0. 11. 8554. 18471.

12583. 36331. 92239. 0. 0. 593. 9136. 29183.

25074. 15898. 25430. 0. 0. 30. 10795. 6294.

8890. 7182. 70319. 0. 8. 13. 21545. 10205.

19702. 2145. 3779. 0. 594. 4490. 14682. 82920.

4511. 1054. 744. 11. 142. 91. 62681. 145233.

115861. 8050. 1510. 89. 163. 454. 59201. 411880.

225489. 15639. 5232. 33. 296. 921. 28358. 226061.

129308. 5591. 4859. 94. 249. 1962. 12846. 33252.

9530. 1741. 1635. 24. 59. 24. 28838. 11570.

8206. 1182. 1066. 0. 0. 0. 1387. 3442.

2916. 664. 1495. 0. 70. 27. 979. 1418.

2137. 1280. 0. 0. 0. 0. 1009. 1170.

1108. 789. 1457. 17. 21. 16. 2425. 2076.

2345. 1143. 1212. 0. 0. 85. 7625. 2759.

761. 2349. 2733. 0. 0. 358. 64897. 19121.

2120. 3192. 3060.

LAND FRACTION

1.00 1.00 1.00 1.00 0.80 0.94 0.88 0.94 0.98 0.95 0.95

1.00 1.00 1.00 1.00 1.00 1.00 0.97 0.98 0.94 0.94 0.96

1.00 1.00 1.00 1.00 1.00 0.96 0.99 1.00 1.00 0.98 0.99

1.00 1.00 1.00 0.96 1.00 1.00 0.98 1.00 1.00 0.98 0.99

1.00 1.00 1.00 0.75 1.00 0.98 0.98 0.99 0.95 0.99 1.00

1.00 1.00 1.00 0.97 0.85 0.25 0.92 0.99 1.00 1.00 1.00

1.00 1.00 1.00 1.00 0.98 1.00 0.99 0.99 0.98 1.00 1.00

1.00 1.00 1.00 1.00 0.94 0.98 0.95 0.97 0.98 1.00 1.00

1.00 1.00 1.00 1.00 1.00 0.80 0.98 1.00 1.00 1.00 0.99

1.00 1.00 1.00 1.00 1.00 0.88 0.90 1.00 1.00 1.00 1.00

1.00 1.00 0.96 0.94 1.00 1.00 1.00 1.00 1.00 1.00 1.00

1.00 1.00 1.00 1.00 1.00 0.98 1.00 1.00 1.00 1.00 0.98

1.00 1.00 1.00 0.98 1.00 1.00 1.00 1.00 1.00 1.00 1.00

1.00 1.00 1.00 0.99 1.00 1.00 0.94 0.99 0.99 0.92 0.96

1.00 1.00 1.00 1.00 1.00 1.00 0.99 1.00 1.00 1.00 0.97

1.00 1.00 1.00 1.00 0.95 1.00 0.99 1.00 0.99 0.99 1.00

REGION INDEX (1=open, 2=woods, 3=buildings)

1 1 1 1 1 1 1 1 1 1 1

1 1 1 1 1 1 1 1 1 1 1

1 1 1 1 1 1 1 1 1 1 1

1 1 1 1 1 1 1 1 1 1 1

1 1 1 1 1 1 1 1 1 1 1

1 1 1 1 1 1 3 2 1 1 1
 1 1 1 1 1 1 3 3 3 1 1
 1 1 1 1 1 1 3 1 1 1 1
 1 1 1 1 1 1 1 1 2 2 2
 1 1 1 1 1 1 1 2 2 2 2
 1 1 1 1 1 1 2 2 2 2 2
 1 1 1 1 1 1 2 2 2 1 2
 1 1 1 1 1 2 2 2 2 2 2
 1 1 1 1 1 2 2 2 2 2 2
 1 1 1 1 1 2 2 2 2 2 2
 1 1 1 1 1 3 2 2 2 2 2

(1=rivers, 2=lakes)

WATERSHED INDEX

1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 2 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1
 1 1 1 1 1 1 1 1 1 1 1

CROP SEASON AND SHARE

1 PASTURE	90.	270.	0.173
2 STORED FORAGE	150.	240.	0.221
3 GRAINS	150.	240.	0.552
4 GRN LEAFY VEGETABLES	150.	240.	0.001
5 OTHER FOOD CROPS	150.	240.	0.000
6 LEGUMES AND SEEDS	150.	240.	0.034
7 ROOTS AND TUBERS	150.	240.	0.019

WATERSHED DEFINITION

11111111112222222222

1 Pu-239	2.0E-5	2.0E-6
2 Pu-241	2.0E-5	2.0E-6

REGIONAL ECONOMIC DATA

1 OPEN	.522	.048	400.	3700.	5000.
2 WOODS/TREES	.0	.0	0.	0.	100000.
3 BUILDINGS	.0	.0	0.	0.	100000.

END

POPULATION

Processing Dose Commitments From IDCFIN.H.DAT

Pu-238	0-50 yr dose commitment to EDE = 8.47E-05
Pu-239	0-50 yr dose commitment to EDE = 9.14E-05
Pu-240	0-50 yr dose commitment to EDE = 9.15E-05
Pu-241	0-50 yr dose commitment to EDE = 1.55E-06
Pu-242	0-50 yr dose commitment to EDE = 8.70E-05
Am-241	0-50 yr dose commitment to EDE = 1.44E-04

USER INPUT IS READ FROM UNIT 26
 RECORD IDENTIFIER FIELDS 11 CHARACTERS LONG ARE EXPECTED.
 THE FIRST 100 COLUMNS OF EACH INPUT RECORD ARE PROCESSED.
 THE MAXIMUM NUMBER OF IDENTIFIER RECORDS THAT MAY BE SAVED AS THE BASE CASE IS 1000.

RECORD
 NUMBER

RECORD

```

*****
*****
* 'CHRONC' USER INPUT FILE for ROCKY FLATS GENERIC ANALYSIS
*
*   Prepared by:   Vern L. Peterson
*                 Safety Analysis Engineering
*                 EG&G Rocky Flats, Inc.
*
*   Major Input Assumptions/Configuration:
*
*   o Any possibility of relocation has been eliminated by setting
*     dose criteria to maximum values - not valid for evacuating/
*     sheltering conditions since criteria at maxima would allow
*     immediate return of evacuees/shelterees
*   o No economic (cost) calculations or D&D
*   o New ingestion/food-pathway model, 50 year exposure period
*
*****
* PROBLEM IDENTIFICATION DATA
*
* Descriptive title for this 'CHRONC' user input
*
1 CHCHNAME001 'COLOCHRN.INP, NO PROT ACTIONS, COSTS, OR DECON, 50 YR EXPOSURE.'
*
*****
* FOOD PATHWAY MODEL SWITCH ('OLD' OR 'NEW')
*
2 CHFDPATH001 'NEW'
*
* DOSE LIMITS TO BE USED WITH THE NEW FOOD PATHWAY MODEL
*
* ANNUAL SHORT TERM PREVENTATIVE DOSE (EDEWBODY) TO BE USED DURING
* FIRST YEAR AFTER THE ACCIDENT (SV)
*
3 CHSTDOSL001 1.E+3      (maximum allowed, to avoid relocation)
*
* ANNUAL LONG TERM PREVENTATIVE DOSE (EDEWBODY) TO BE USED DURING
* ALL SUBSEQUENT YEARS (SV)
*
4 CHLTDOSL001 1.E+3      (maximum allowed, to avoid relocation)
*
* ORGAN TO BE USED FOR PROJECTING DOSES TO AN INFANT TO DETERMINE MILK
* DISPOSAL
*
*CHIDSORG001 'L-THYROID'
5 CHIDSORG001 'L-EDEWBODY'
*
* ANNUAL PREVENTATIVE DOSE ALLOWED TO THE ORGAN (IDSORG) FOR AN INFANT (SV)
*
6 CHINDOSL001 1.E+3      (maximum allowed, to avoid relocation)
*
* ECONOMIC DATA FOR THE NEW FOOD PATHWAY MODEL
*
* MTFRCT = FRACTION OF FARMS SALES THAT COMES FROM MEAT
* CDFRCT = FRACTION OF SALES OF CROPS THAT IS PROFITS
*
*
*      MTFRCT      CDFRCT
7 CHNFECT001      0.12      0.02
*
*****
* NUMBER OF DEFINED CROPS IN THE CHRONC FOOD INGESTION MODEL

```


*
8 CHNFICRP001 7 (UP TO 10 ALLOWED)
*

* NOTE TO USER: THE CODE MAKES SPECIAL TREATMENT OF CROP NAMES BEGINNING
* WITH 'PASTURE' DUE TO THE CONTINUOUS NATURE OF THE HARVESTING PROCESS.
* IF THE USER WISHES TO DEFINE A NEW CROP CATEGORY FOR RANGELAND PASTURE,
* IT SHOULD BE CALLED 'PASTURE-RANGE' OR 'PASTURE-DRY'.
*

FRACTION OF CROP CONSUMED BY

	CROP NAME	MAN	DAIRY ANIMALS	BEEF ANIMALS	POULTRY	OTHER ANIMALS
	NAMCRP	FRCTCH	FRCTCM	FRCTCB	FRCTCP	FRCTCO
9	CHCRPTBL001 'PASTURE	' 0.0	0.1	0.9	0.0	0.0
10	CHCRPTBL002 'STORED FORAGE	' 0.0	0.13	0.87	0.0	0.0
11	CHCRPTBL003 'GRAINS	' 0.35	0.039	0.273	0.195	0.143
12	CHCRPTBL004 'LEGUMES AND SEEDS	' 0.24	0.046	0.327	0.235	0.152
13	CHCRPTBL005 'GRN LEAFY VEGETABLES'	1.0	0.0	0.0	0.0	0.0
14	CHCRPTBL006 'ROOTS AND TUBERS	' 1.0	0.0	0.0	0.0	0.0
15	CHCRPTBL007 'OTHER FOOD CROPS	' 1.0	0.0	0.0	0.0	0.0

* EMERGENCY RESPONSE COST DATA

* Daily evacuation cost for food & housing but not lost income (\$/person-day)
* ('0' since economics are not considered)
*

16 CHEVACST001 0.

* Daily relocation cost for food & housing but not lost income (\$/person-day)
* ('0' since economics are not considered)
*

17 CHRELCST001 0.

* LONG-TERM PROTECTIVE ACTION DATA

* Time at which INTERMEDIATE phase ends (s from accident initiation)
* (equal to EMERGENCY phase thereby eliminating INTERMEDIATE phase)
*

18 CHTMIPND001 604800. * one week

* Long-term dose projection period for decontamination/interdiction (s)
* ('min' since decontamination/interdiction is not considered)
*

19 CHTMPACT001 604800. * one week

* Intermediate phase dose criterion for relocation (Sv)
* ('max' since relocation is not considered)
*

20 CHDSCRTI001 1.0E+5

* Dose criterion for long-term phase relocation (Sv)
* ('max' since relocation is not considered)
*

21 CHDSCRLT001 1.0E+5

* Critical organ name for long-term actions
* (unimportant since dose limits are at maximums)
*

22 CHCRTOCRO01 'L-EDEWBODY'

* Long-term exposure period. Previous version of MACCS hardwired to 1E6 yrs.
*

23 CHEXPTIM001 1.575E9 * seconds (50 years, recommended in MACCS2 documents)

* DECONTAMINATION PLAN DATA

```

*
* Number of decontamination levels
* (although decon is not considered, a '0' is invalid)
*
24 CHLVLDEC001 1
*
* Time required to complete each decontamination level (s)
* ('max' since decontamination is not considered)
*
25 CHTIMDEC001 3.15E+7 * one year
*
* Dose reduction factors for each decontamination level
* ('min' (no dose reduction) since decontamination is not considered)
*
26 CHDSRFCT001 1.
*
* Cost of farm decontamination for each decontamination level ($/hectare)
* ('0' since decontamination is not considered)
*
27 CHCDFRM0001 0.
*
* Cost of nonfarm decontamination for each decontamination level ($/person)
* ('0' since decontamination is not considered)
*
28 CHCDNFRM001 0.
*
* Fraction of farm decontamination cost due to labor for each decon level
* ('0' since decontamination is not considered)
*
29 CHFRFDL0001 0.
*
* Fraction of nonfarm decontamination cost due to labor for each decon level
* ('0' since decontamination is not considered)
*
30 CHFRNFDL001 0.
*
* Fraction of time farm decon workers spend in contaminated areas for each
* decontamination level
* ('0' since decontamination is not considered)
*
31 CHTFWKF0001 0.
*
* Fraction of time nonfarm decon workers spend in contaminated areas for each
* decontamination level
* ('0' since decontamination is not considered)
*
32 CHTFWKNF001 0.
*
* Average cost of decontamination labor ($/man-yr)
* ('0' since decontamination is not considered)
*
33 CHDLBCST001 0.
*
*****
* INTERDICTION PLAN COST DATA
*
* Depreciation (deterioration) rate during interdiction (per yr)
* ('0' since economics are not considered)
*
34 CHDPRATE001 0.
*
* Inflation-adjusted investment rate of return during interdiction (per yr)
* ('0' since economics are not considered)
*
35 CHDSRATE001 0.
*
* Relocation cost including alternate housing, moving costs, & lost income
* for decontamination, interdiction, &/or condemnation areas ($/person)
* ('min' since economics are not considered)

```

```

*
36 CHPOPCST001 1.0E-35
*
*****
* GROUNDSHINE WEATHERING DATA
*
* Number of terms in groundshine weathering (Gale's) equation (either 1 or 2)
*
37 CHNGWTRM001 2
*
* Groundshine weathering coefficients
* (Ref. Jon Helton; used in NUREG-1150, 2nd Draft)
*
38 CHGWCDEF001 .5 .5
*
* Half-lives corresponding to the groundshine weathering coefficients (s)
* (Ref. Jon Helton; used in NUREG-1150, 2nd Draft)
*
39 CHTGWHLF001 1.6E+7 2.8E+9 * 6 months and 90 years
*
*****
* RESUSPENSION WEATHERING DATA
*
* Number of terms in the resuspension weathering relationship
*
40 CHNRWTRM001 3
*
* Resuspension concentration coefficients (per m)
* (Ref. Jon Helton; used in NUREG-1150, 2nd Draft)
*
41 CHRWCDEF001 1.0E-5 1.0E-7 1.0E-9
*
* Half-lives corresponding to the resuspension concentration coefficients (s)
* (Ref. Jon Helton; used in NUREG-1150, 2nd Draft)
*
42 CHTRWHLF001 1.6E+7 1.6E+8 1.6E+9 * 6 months, 5 years, 50 years
*
*****
* REGIONAL CHARACTERISTICS DATA
*
* Fraction of grid area that is land
* (site file data overrides this value if POPFLG = FILE)
*
43 CHFRACLD001 0.99 * Colorado guess
*
* Fraction of land devoted to farming in the grid area
* (site file data overrides this value if POPFLG = FILE)
*
44 CHFRCFRM001 0.5533 * For area within 50 miles of RFP, based on TRAC data
*
* Average value of annual farm production in the grid area ($/hectare)
* (farm cash receipts + value of home consumption)/(land in farms)
* ('0' since economics are not considered)
*
45 CHFRMPRD001 0.
*
* Fraction of farm production resulting from dairy production in the grid area
* (value of milk produced)/(cash receipts from farming plus home consumption)
* ('0' since economics are not considered)
*
46 CHDPFRCT001 0.
*
* Value of farm wealth in the grid area ($/hectare)
* ('min' since economics are not considered)
*
47 CHVALWF0001 1.0E-35
*
* Fraction of farm wealth due to improvements in the grid area
* ('0' since economics are not considered)

```

```

*
48 CHFRFIM0001  0.
*
*   Nonfarm wealth, property, & improvements in the grid area ($/person)
*   ('min' since economics are not considered)
*
49 CHVALWNF001  1.0E-35
*
*   Fraction of nonfarm wealth due to improvements in the grid area
*   ('0' since economics are not considered)
*
50 CHFRNFIM001  0.
*
*****
*   WATER PATHWAY PARAMETERS
*
*   Number of nuclides (defined in table) in water ingestion pathways
*
51 CHNUMWPI001  2
*
*   Table of nuclides, washoff fractions, and ingestion factors for the
*   chronic drinking water pathway model. The set of drinking water
*   pathway nuclides must be a subset of the set of nuclides specified
*   for the food pathway model. These data are taken, or computed, from
*   NUREG/CR-4551. The WSHFRI values for Pu are not given there, but these
*   are generally 5 to 10 times larger than the WSHRTA values, which are
*   given for Pu. WINGF is computed as  $WT \cdot WC \cdot POP / D$ , where WT is one or less
*   (perhaps as low as 0.1), WC = 400 liters/yr-ind, POP = 2E6 individuals,
*   and D (total river discharge rate) = (total precipitation within 50 miles)
*   =  $(\pi)(50 \text{ cm/yr})(80 \text{ km})^2 / (1000 \text{ cc/liter}) = 1E13 \text{ liters/yr}$ , giving
*    $WINGF = (0.1 \text{ to } 1)(400)(2E6) / (1E13) = (8 \text{ to } 80)E-6$ ; use 2E-5.
*
*
*           INITIAL    ANNUAL    INGESTION FACTOR
*           WASHOFF    WASHOFF    (BQ INGESTED/
*           FRACTION    RATE      BQ IN WATER)
*
*           NUCLIDE
*
*           NAMWPI    WSHFRI    WSHRTA    WINGF
52 CHWTRIS0001  Pu-239    .01      .001    2.E-5
53 CHWTRIS0002  Pu-241    .01      .001    2.E-5
*
*****
*   CROP SHARE & GROWING SEASON DATA
*
*   If a site data file is being used (as specified in 'EARLY' user input), then
*   data from the site file (& not the data below) are used for calculation of
*   doses & costs. If a site file is not specified, the data below are used.
*   The values used here are specific to Colorado, based on 1991 data.
*
*
*           GROWING SEASON
*           (DAYS)
*           START    END    FARMLAND
*           CROP NAME
*
*           NAMCRP    TGSBEG    TGSEND    FRCTFL
54 CHCRPRGN001  'PASTURE    '    90.    270.    0.173
55 CHCRPRGN002  'STORED FORAGE    '    150.    240.    0.221
56 CHCRPRGN003  'GRAINS    '    150.    240.    0.552
57 CHCRPRGN004  'LEGUMES AND SEEDS    '    150.    240.    0.034
58 CHCRPRGN005  'GRN LEAFY VEGETABLES    '    150.    240.    0.001
59 CHCRPRGN006  'ROOTS AND TUBERS    '    150.    240.    0.019
60 CHCRPRGN007  'OTHER FOOD CROPS    '    150.    240.    0.000
*
*****
*   DIAGNOSTIC TRACE OPTIONS (SPECIAL OUTPUT) DATA
*
*   Detailed print option control switches; look at the code before turning on!!
*   (ground concentration print option does not work!)
*
*
*           KCEPNT    KDFPNT    KDPNT    KGPCNT    KLTPNT    KWTPNT    KSWRSK    KSWDSC
61 CHKSWTCH001  0    0    0    0    0    0    0    0

```

```

*
*****
* USER REQUESTED POPULATION DOSE RESULTS (T9)
*
* Long-term population doses by region
*
* Number of results of this type that are being requested where a set of 12
* outputs is produced for each result requested
*
62 TYPE9NUMBER 1
*
* Organ Inner Outer
*
63 TYPE9OUT001 'L-EDEWBODY' 1 11 (0 - 50 miles)
*
*****
* USER REQUESTED ECONOMIC COSTS RESULTS (T10)
*
* Economic costs of emergency response & long-term protective actions by region
*
* Number of results of this type that are being requested where a set of 12
* outputs is produced for each result requested
* (not needed here as costs are not of interest in this project)
*
64 TYP10NUMBER 0
*
*****
* USER REQUESTED ACTION DISTANCE RESULTS (T11)
*
* Maximum distances associated with long-term actions of decontamination,
* interdiction, & crop disposal
*
* Flag set to .TRUE. results in output of all 8 action distance results
* (not needed here as D&D activities not of interest)
*
65 TYP11FLAG11 .FALSE.
*
*****
* USER REQUESTED IMPACTED AREA/POPULATION RESULTS (T12)
*
* Impacted area/population results by region
*
* Number of results of this type that are being requested where a set of 8
* outputs is produced for each result requested.
* (not needed here as D&D activities not of interest)
*
66 TYP12NUMBER 0
*
*****
* DOSE TO AN AVERAGE INDIVIDUAL AT A SPECIFIED RADIAL DISTANCE IN A SPECIFIED
* DIRECTION FROM THE SITE OF THE RELEASE FOR A SPECIFIED EXPOSURE PERIOD
*
* NUMBER OF RESULTS OF THIS TYPE THAT ARE BEING REQUESTED
*
67 TYP13NUMBER 4 (UP TO 20 ALLOWED)
*
* RADIAL DISTANCE CORRESPONDING TO THE RADIAL DISTANCES DEFINED IN THE
* ATMOS USER INPUT FILE (MAXIMUM = MAXRAD)
* ANGULAR DIRECTION FROM 1 TO 16 WITH 1 BEING NORTH AND CONTINUING CLOCKWISE
* EXPOSURE PERIODS ARE FOR NUMBER OF YEARS UP TO 8 OR A LIFETIME (50 YEARS)
* (NOTE: TO SPECIFY A LIFETIME EXPOSURE PERIOD, SET YEARS TO 9)
*
* CCDF CAN BE REQUESTED
*
* IRAD13 IANG13 IEXP13
*
68 TYP13OUT001 3 6 1
69 TYP13OUT002 3 6 2
70 TYP13OUT003 3 6 5

```

71 TYP13OUT004 3 6 9

*

* POPULATION EXCEEDING A USER-SPECIFIED ANNUAL DOSE LIMIT TO A SPECIFIED ORGAN
* FROM THE FOOD PATHWAY ONLY

*

72 TYP14NUMBER 3 (UP TO 20 ALLOWED)

*

* ORGAN DOSE LIMIT (REM) 1YR14

*

73 TYP14OUT001 'L-EDEWBODY' 0.0 1

74 TYP14OUT002 'L-EDEWBODY' 0.0 8

75 TYP14OUT003 'L-EDEWBODY' 1.0 1

*

* END OF 'CHRONC' USER INPUT FILE

***** TERMINATOR RECORD ENCOUNTERED -- END OF BASE CASE USER INPUT *****

USER INPUT PROCESSING SUMMARY - BASE CASE

NUMBER OF RECORDS READ = 423

NUMBER OF BLANK OR COMMENT RECORDS READ = 347

NUMBER OF TERMINATOR RECORDS = 1

NUMBER OF RECORDS PROCESSED = 75

NUMBER OF PROCESSED RECORDS DUPLICATED = 0

NUMBER OF PROCESSED RECORDS SORTED = 75

COCINA FILE USED:

THREE NUCLIDES

COCINA 05/28/93 12:31:50 TEST OUTPUT FILE

HTF VALUES SUCCESSFULLY READ FROM COCMAX.INP

AICF VALUES SUCCESSFULLY READ FROM COCMAX.INP

SHMLK VALUES SUCCESSFULLY READ FROM COCMAX.INP

HTFINF VALUES SUCCESSFULLY READ FROM COCMAX.INP

Processing Ingestion Dose Commitments From IDCING.DAT

Pu-239 0-50 yr dose commitment to EDE = 1.54E-08

Pu-241 0-50 yr dose commitment to EDE = 2.53E-10

Am-241 0-50 yr dose commitment to EDE = 5.90E-07

FRCTCH FRCTCM FRCTCB FRCTCP FRCTCO FRCTFL

BEFORE SORTING:

PASTURE	0.00E+00	1.00E-01	9.00E-01	0.00E+00	0.00E+00	1.73E-01
STORED FORAGE	0.00E+00	1.30E-01	8.70E-01	0.00E+00	0.00E+00	2.21E-01
GRAINS	3.50E-01	3.90E-02	2.73E-01	1.95E-01	1.43E-01	5.52E-01
LEGUMES AND SEEDS	2.40E-01	4.60E-02	3.27E-01	2.35E-01	1.52E-01	3.40E-02
GRN LEAFY VEGETABLES	1.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-03
ROOTS AND TUBERS	1.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E-02
OTHER FOOD CROPS	1.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I AM SORTING						

AFTER SORTING:

PASTURE	0.00E+00	1.00E-01	9.00E-01	0.00E+00	0.00E+00	1.73E-01
STORED FORAGE	0.00E+00	1.30E-01	8.70E-01	0.00E+00	0.00E+00	2.21E-01
GRAINS	3.50E-01	3.90E-02	2.73E-01	1.95E-01	1.43E-01	5.52E-01
LEGUMES AND SEEDS	2.40E-01	4.60E-02	3.27E-01	2.35E-01	1.52E-01	3.40E-02
GRN LEAFY VEGETABLES	1.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E-03
ROOTS AND TUBERS	1.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.90E-02
OTHER FOOD CROPS	1.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

A SITE DATA FILE IS BEING USED FOR BOTH "EARLY" AND "CHRONC"

3 CANCER EFFECTS ARE DEFINED IN THE MODEL.

INDEX	CANCER EFFECT	ORGAN	ALPHA	BETA	CFRISK	CIRISK
1	BONE	L-BONE SUR	1.000E+00	0.000E+00	6.000E-05	6.000E-05
2	LUNG	L-LUNGS	1.000E+00	0.000E+00	8.000E-03	8.000E-03
3	LIVER	L-LIVER	1.000E+00	0.000E+00	1.500E-03	1.500E-03

TIME OF HOTSPOT RELOCATION IS 6.0480E+05.

TIME OF NORMAL RETURN IS 6.048E+05 AND THE EMERGENCY PHASE ENDS AT 6.048E+05.

GROUNDSHINE SHIELDING FACTOR = 0.330

RESUSPENSION PROTECTION FACTOR = 0.410

BREATHING RATE (CUBIC M/S) = 3.330E-04

DISPERSION MODEL FLAG IS 3

WINDROSE PROBABILITIES BY WIND DIRECTION AND MET BIN NUMBER

BIN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0.0423	0.0197	0.0187	0.0167	0.0147	0.0187	0.0157	0.0324	0.0462	0.0855	0.0885	0.1042	0.1180	0.1858	0.1288	0.0639
2	0.0151	0.0272	0.0060	0.0121	0.0272	0.0181	0.0453	0.0272	0.0453	0.1299	0.1148	0.0997	0.0483	0.1541	0.1541	0.0755
3	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4	0.0614	0.0614	0.1009	0.0658	0.1272	0.0658	0.0833	0.0965	0.0614	0.0614	0.0307	0.0351	0.0132	0.0351	0.0570	0.0439
5	0.0714	0.0677	0.0665	0.0653	0.1182	0.0924	0.0948	0.0788	0.0961	0.0320	0.0271	0.0209	0.0160	0.0259	0.0653	0.0616
6	0.0769	0.0593	0.0763	0.0769	0.0847	0.0906	0.0893	0.1010	0.0867	0.0548	0.0313	0.0189	0.0117	0.0241	0.0411	0.0763
7	0.0310	0.0215	0.0572	0.1001	0.1097	0.2431	0.1371	0.0834	0.0822	0.0465	0.0167	0.0048	0.0036	0.0000	0.0238	0.0393
8	0.0043	0.0014	0.0072	0.0487	0.2235	0.4713	0.1433	0.0301	0.0287	0.0215	0.0143	0.0000	0.0000	0.0000	0.0000	0.0057
9	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
10	0.0319	0.0585	0.0745	0.1064	0.1383	0.1489	0.1011	0.1011	0.0532	0.0479	0.0372	0.0213	0.0160	0.0106	0.0213	0.0319
11	0.0659	0.0835	0.0725	0.1121	0.1385	0.1363	0.1033	0.0593	0.0527	0.0198	0.0198	0.0066	0.0110	0.0066	0.0857	0.0264
12	0.0540	0.1018	0.1608	0.2261	0.0716	0.0515	0.0905	0.1281	0.0503	0.0151	0.0063	0.0050	0.0025	0.0038	0.0063	0.0264
13	0.0000	0.0000	0.2500	0.0000	0.0000	0.2500	0.0000	0.0000	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
14	0.0625	0.0517	0.0948	0.0948	0.1121	0.1013	0.1034	0.0711	0.0625	0.0453	0.0323	0.0345	0.0237	0.0474	0.0259	0.0366
15	0.0591	0.0714	0.1207	0.1256	0.1108	0.0862	0.0936	0.0862	0.0493	0.0345	0.0197	0.0123	0.0246	0.0271	0.0296	0.0493
16	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
17	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
18	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
19	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
20	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
21	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
22	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
23	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
24	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
25	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
26	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
27	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
28	0.0314	0.0172	0.0142	0.0243	0.0325	0.0406	0.0700	0.1156	0.1572	0.1531	0.0781	0.0578	0.0538	0.0497	0.0467	0.0578
29	0.0491	0.0466	0.0630	0.0793	0.0916	0.1188	0.0881	0.0804	0.0748	0.0599	0.0401	0.0326	0.0293	0.0452	0.0513	0.0499
30	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
31	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
32	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
33	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
34	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
35	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
36	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
37	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
38	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
39	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
40	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
41	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MACCS SITE DATA FILE FOR ROCKY FLATS PLANT OUT TO 50 MILES
GENERIC WG Pu

THIS PROGRAM CURRENTLY ALLOWS THE GENERATION OF UP TO 394 RESULTS

YOU HAVE REQUESTED 61 RESULTS FROM "EARLY" COMPOSED OF:

4 RESULTS OF TYPE 1
1 RESULTS OF TYPE 2
1 RESULTS OF TYPE 3
2 RESULTS OF TYPE 4
4 RESULTS OF TYPE 5
0 RESULTS OF TYPE 6
0 RESULTS OF TYPE 7
5 RESULTS OF TYPE 8
44 RESULTS OF TYPE A

YOU HAVE REQUESTED 19 RESULTS FROM "CHRONC" COMPOSED OF:

12 RESULTS OF TYPE 9
0 RESULTS OF TYPE 10
0 RESULTS OF TYPE 11
0 RESULTS OF TYPE 12
4 RESULTS OF TYPE 13
3 RESULTS OF TYPE 14

TRIAL	DAY	HOUR	BIN	PRBMET
1	153	5	18	1.94E-03
2	153	13	21	1.88E-03
3	153	14	26	7.42E-04
4	153	15	25	2.94E-03
5	161	17	1	2.90E-02
6	163	17	28	3.17E-03
7	167	15	2	9.45E-03
8	170	20	12	2.27E-02
9	171	9	6	4.38E-02
10	172	21	27	1.34E-03
11	175	17	4	6.51E-03
12	180	12	24	2.65E-03
13	180	15	23	1.20E-03
14	187	14	20	5.37E-03
15	190	13	26	7.42E-04
16	192	4	10	5.37E-03
17	194	14	22	8.85E-04
18	196	20	7	2.39E-02
19	200	8	28	3.17E-03
20	200	14	26	7.42E-04
21	201	19	27	1.34E-03
22	201	22	25	2.94E-03
23	205	9	19	2.43E-03
24	208	22	5	2.32E-02
25	217	2	15	1.16E-02
26	218	6	13	1.14E-04
27	219	19	11	1.30E-02
28	225	13	17	3.60E-03
29	230	9	28	3.17E-03
30	232	14	6	4.38E-02
31	238	13	27	1.34E-03
32	240	15	1	2.90E-02
33	240	16	2	9.45E-03
34	252	2	5	2.32E-02
35	255	4	14	1.32E-02
36	269	5	8	1.99E-02
37	271	22	12	2.27E-02
38	279	16	19	2.43E-03
39	280	22	18	1.94E-03
40	285	21	15	1.16E-02
41	287	15	7	2.39E-02
42	288	19	10	5.37E-03
43	289	13	2	9.45E-03
44	294	4	14	1.32E-02
45	305	9	20	5.37E-03
46	321	10	4	6.51E-03
47	322	2	11	1.30E-02
48	324	3	9	1.14E-04
49	325	17	25	2.94E-03
50	326	7	17	3.60E-03

TRIAL	DAY	HOUR	BIN	PRBMET
51	328	3	24	2.65E-03
52	328	6	22	8.85E-04
53	331	21	13	1.14E-04
54	333	18	23	1.20E-03
55	334	7	10	5.37E-03
56	348	16	3	1.14E-04
57	350	15	20	5.37E-03
58	355	2	5	2.32E-02
59	356	21	15	1.16E-02
60	357	7	8	1.99E-02
61	363	9	4	6.51E-03
62	4	4	13	1.14E-04
63	7	5	17	3.60E-03
64	7	22	19	2.43E-03
65	10	19	14	1.32E-02
66	12	7	21	1.88E-03
67	12	18	18	1.94E-03
68	22	10	7	2.39E-02
69	24	20	8	1.99E-02
70	31	24	11	1.30E-02
71	42	8	1	2.90E-02
72	44	1	11	1.30E-02
73	46	20	12	2.27E-02
74	51	18	6	4.38E-02
75	53	7	14	1.32E-02
76	66	5	15	1.16E-02
77	68	12	28	3.17E-03
78	76	15	21	1.88E-03
79	78	16	5	2.32E-02
80	79	3	4	6.51E-03
81	81	12	24	2.65E-03
82	84	11	20	5.37E-03
83	88	3	25	2.94E-03
84	97	11	6	4.38E-02
85	103	9	1	2.90E-02
86	106	14	22	8.85E-04
87	106	19	17	3.60E-03
88	106	24	23	1.20E-03
89	107	9	24	2.65E-03
90	107	16	27	1.34E-03
91	111	23	13	1.14E-04
92	114	11	8	1.99E-02
93	114	18	12	2.27E-02
94	128	10	2	9.45E-03
95	130	23	19	2.43E-03
96	132	5	7	2.39E-02
97	141	13	22	8.85E-04
98	146	13	26	7.42E-04
99	147	21	18	1.94E-03
100	148	13	23	1.20E-03
101	148	17	21	1.88E-03
102	151	3	10	5.37E-03

DATE AND TIME OF RUN = MACCS2 11/24/93 13:13:35 Fixed Noble Gas Omission: Version 1.02, 5/3/93
 "ATMOS" DESCRIPTION = WSNATM.INP, RFP METEOROLOGICAL DATA, EPA METHOD, NO WAKE EFFECTS

	QUANTILES							PEAK	PEAK	PEAK
	PROB	NON-ZERO	MEAN	50TH	90TH	95TH	99TH	99.9TH	CONS	PROB TRIAL
Source Term 1, Plume 1, at 0.6-3.2 KM										
Pu-239 Centerline Air Conc.	1.0000	3.88E+04	1.46E+04	1.05E+05	1.74E+05	3.07E+05	3.66E+05	3.88E+05	4.57E-04	26
Pu-239 Ground-Level Air Conc.	1.0000	3.88E+04	1.46E+04	1.05E+05	1.74E+05	3.07E+05	3.66E+05	3.88E+05	4.57E-04	26
Pu-239 Centerline Ground Conc.	1.0000	4.32E+01	1.54E+01	1.18E+02	1.92E+02	3.32E+02	NOT-FOUND	3.99E+02	2.94E-03	22
Total Centerline Ground Conc.	1.0000	3.09E+02	1.18E+02	1.05E+03	1.38E+03	2.27E+03	NOT-FOUND	2.86E+03	2.94E-03	22
Ground-Level X/Q (everything in SI)	1.0000	1.91E-05	7.67E-06	5.64E-05	9.16E-05	1.24E-04	1.77E-04	2.05E-04	4.57E-04	26
Pu-239 Adjusted Source, Q	1.0000	2.10E+09	2.02E+09	2.07E+09	2.10E+09	NOT-FOUND	NOT-FOUND	2.13E+09	1.99E-02	60
Plume Sigma-Y (m)	1.0000	1.56E+02	1.20E+02	2.56E+02	NOT-FOUND	NOT-FOUND	NOT-FOUND	3.27E+02	6.76E-02	3
Plume Sigma-Z (m)	0.9978	5.17E+02	6.35E+01	6.09E+02	NOT-FOUND	NOT-FOUND	NOT-FOUND	5.66E+03	6.54E-02	3
Plume Height (m)	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
Plume Arrival Time (s)	1.0000	6.75E+02	6.26E+02	1.08E+03	1.17E+03	1.43E+03	1.91E+03	2.11E+03	6.85E-04	26

RESULT NAME = Source Term 1, Plume 1, at 0.6-3.2 KM
Pu-239 Centerline Air Conc.

1.00E-02	1.00E+00
2.00E-02	1.00E+00
3.00E-02	1.00E+00
5.00E-02	1.00E+00
7.00E-02	1.00E+00
1.00E-01	1.00E+00
2.00E-01	1.00E+00
3.00E-01	1.00E+00
5.00E-01	1.00E+00
7.00E-01	1.00E+00
1.00E+00	1.00E+00
2.00E+00	1.00E+00
3.00E+00	1.00E+00
5.00E+00	1.00E+00
7.00E+00	1.00E+00
1.00E+01	1.00E+00
2.00E+01	1.00E+00
3.00E+01	1.00E+00
5.00E+01	1.00E+00
7.00E+01	1.00E+00
1.00E+02	1.00E+00
2.00E+02	1.00E+00
3.00E+02	9.68E-01
5.00E+02	9.63E-01
7.00E+02	9.63E-01
1.00E+03	9.32E-01
2.00E+03	8.45E-01
3.00E+03	8.14E-01
5.00E+03	6.51E-01
7.00E+03	6.31E-01
1.00E+04	5.80E-01
2.00E+04	4.41E-01
3.00E+04	3.60E-01
5.00E+04	1.75E-01
7.00E+04	1.20E-01
1.00E+05	1.06E-01
2.00E+05	4.14E-02
3.00E+05	1.37E-02
3.88E+05	4.57E-04

RESULT NAME = Source Term 1, Plume 1, at 0.6-3.2 KM
Pu-239 Ground-Level Air Conc.

1.00E-02	1.00E+00
2.00E-02	1.00E+00
3.00E-02	1.00E+00
5.00E-02	1.00E+00
7.00E-02	1.00E+00
1.00E-01	1.00E+00
2.00E-01	1.00E+00
3.00E-01	1.00E+00
5.00E-01	1.00E+00
7.00E-01	1.00E+00
1.00E+00	1.00E+00
2.00E+00	1.00E+00
3.00E+00	1.00E+00
5.00E+00	1.00E+00
7.00E+00	1.00E+00
1.00E+01	1.00E+00
2.00E+01	1.00E+00
3.00E+01	1.00E+00
5.00E+01	1.00E+00
7.00E+01	1.00E+00
1.00E+02	1.00E+00
2.00E+02	1.00E+00
3.00E+02	9.68E-01
5.00E+02	9.63E-01
7.00E+02	9.63E-01
1.00E+03	9.32E-01
2.00E+03	8.45E-01
3.00E+03	8.14E-01
5.00E+03	6.51E-01
7.00E+03	6.31E-01
1.00E+04	5.80E-01
2.00E+04	4.41E-01
3.00E+04	3.60E-01
5.00E+04	1.75E-01
7.00E+04	1.20E-01
1.00E+05	1.06E-01
2.00E+05	4.14E-02
3.00E+05	1.37E-02
3.88E+05	4.57E-04

RESULT NAME = Source Term 1, Plume 1, at 0.6-3.2 KM
Pu-239 Centerline Ground Conc.

1.00E-05	1.00E+00
2.00E-05	1.00E+00
3.00E-05	1.00E+00
5.00E-05	1.00E+00
7.00E-05	1.00E+00
1.00E-04	1.00E+00
2.00E-04	1.00E+00
3.00E-04	1.00E+00
5.00E-04	1.00E+00
7.00E-04	1.00E+00
1.00E-03	1.00E+00
2.00E-03	1.00E+00
3.00E-03	1.00E+00
5.00E-03	1.00E+00
7.00E-03	1.00E+00
1.00E-02	1.00E+00
2.00E-02	1.00E+00
3.00E-02	1.00E+00
5.00E-02	1.00E+00
7.00E-02	1.00E+00
1.00E-01	1.00E+00
2.00E-01	1.00E+00
3.00E-01	9.68E-01
5.00E-01	9.63E-01
7.00E-01	9.63E-01
1.00E+00	9.32E-01
2.00E+00	8.50E-01
3.00E+00	8.21E-01
5.00E+00	6.59E-01
7.00E+00	6.39E-01
1.00E+01	5.88E-01
2.00E+01	4.53E-01
3.00E+01	3.84E-01
5.00E+01	2.03E-01
7.00E+01	1.47E-01
1.00E+02	1.26E-01
2.00E+02	4.73E-02
3.00E+02	1.96E-02
3.99E+02	2.94E-03

RESULT NAME = Source Term 1, Plume 1, at 0.6-3.2 KM
Total Centerline Ground Conc.

1.00E-04	1.00E+00
2.00E-04	1.00E+00
3.00E-04	1.00E+00
5.00E-04	1.00E+00
7.00E-04	1.00E+00
1.00E-03	1.00E+00
2.00E-03	1.00E+00
3.00E-03	1.00E+00
5.00E-03	1.00E+00
7.00E-03	1.00E+00
1.00E-02	1.00E+00
2.00E-02	1.00E+00
3.00E-02	1.00E+00
5.00E-02	1.00E+00
7.00E-02	1.00E+00
1.00E-01	1.00E+00
2.00E-01	1.00E+00
3.00E-01	1.00E+00
5.00E-01	1.00E+00
7.00E-01	1.00E+00
1.00E+00	1.00E+00
2.00E+00	1.00E+00
3.00E+00	9.64E-01
5.00E+00	9.63E-01
7.00E+00	9.32E-01
1.00E+01	8.81E-01
2.00E+01	8.21E-01
3.00E+01	7.09E-01
5.00E+01	6.39E-01
7.00E+01	5.88E-01
1.00E+02	5.34E-01
2.00E+02	4.06E-01
3.00E+02	2.57E-01
5.00E+02	1.47E-01
7.00E+02	1.29E-01
1.00E+03	1.12E-01
2.00E+03	1.96E-02
2.86E+03	2.94E-03

RESULT NAME = Source Term 1, Plume 1, at 0.6-3.2 KM
Ground-Level X/Q (everything in S1)

1.00E-11	1.00E+00
2.00E-11	1.00E+00
3.00E-11	1.00E+00
5.00E-11	1.00E+00
7.00E-11	1.00E+00
1.00E-10	1.00E+00
2.00E-10	1.00E+00
3.00E-10	1.00E+00
5.00E-10	1.00E+00
7.00E-10	1.00E+00
1.00E-09	1.00E+00
2.00E-09	1.00E+00
3.00E-09	1.00E+00
5.00E-09	1.00E+00
7.00E-09	1.00E+00
1.00E-08	1.00E+00
2.00E-08	1.00E+00
3.00E-08	1.00E+00
5.00E-08	1.00E+00
7.00E-08	1.00E+00
1.00E-07	1.00E+00
2.00E-07	9.64E-01
3.00E-07	9.63E-01
5.00E-07	9.32E-01
7.00E-07	8.77E-01
1.00E-06	8.45E-01
2.00E-06	7.01E-01
3.00E-06	6.31E-01
5.00E-06	5.80E-01
7.00E-06	5.22E-01
1.00E-05	4.41E-01
2.00E-05	2.31E-01
3.00E-05	1.39E-01
5.00E-05	1.06E-01
7.00E-05	8.95E-02
1.00E-04	4.14E-02
2.00E-04	4.57E-04
2.05E-04	4.57E-04

RESULT NAME = Source Term 1, Plume 1, at 0.6-3.2 KM
Pu-239 Adjusted Source, Q

1.00E+03	1.00E+00
2.00E+03	1.00E+00
3.00E+03	1.00E+00
5.00E+03	1.00E+00
7.00E+03	1.00E+00
1.00E+04	1.00E+00
2.00E+04	1.00E+00
3.00E+04	1.00E+00
5.00E+04	1.00E+00
7.00E+04	1.00E+00
1.00E+05	1.00E+00
2.00E+05	1.00E+00
3.00E+05	1.00E+00
5.00E+05	1.00E+00
7.00E+05	1.00E+00
1.00E+06	1.00E+00
2.00E+06	1.00E+00
3.00E+06	1.00E+00
5.00E+06	1.00E+00
7.00E+06	1.00E+00
1.00E+07	1.00E+00
2.00E+07	1.00E+00
3.00E+07	1.00E+00
5.00E+07	1.00E+00
7.00E+07	1.00E+00
1.00E+08	1.00E+00
2.00E+08	1.00E+00
3.00E+08	1.00E+00
5.00E+08	1.00E+00
7.00E+08	1.00E+00
1.00E+09	1.00E+00
2.00E+09	1.00E+00
2.13E+09	1.99E-02

RESULT NAME = Source Term 1, Plume 1, at 0.6-3.2 KM
Plume Sigma-Y (m)

1.00E-04	1.00E+00
2.00E-04	1.00E+00
3.00E-04	1.00E+00
5.00E-04	1.00E+00
7.00E-04	1.00E+00
1.00E-03	1.00E+00
2.00E-03	1.00E+00
3.00E-03	1.00E+00
5.00E-03	1.00E+00
7.00E-03	1.00E+00
1.00E-02	1.00E+00
2.00E-02	1.00E+00
3.00E-02	1.00E+00
5.00E-02	1.00E+00
7.00E-02	1.00E+00
1.00E-01	1.00E+00
2.00E-01	1.00E+00
3.00E-01	1.00E+00
5.00E-01	1.00E+00
7.00E-01	1.00E+00
1.00E+00	1.00E+00
2.00E+00	1.00E+00
3.00E+00	1.00E+00
5.00E+00	1.00E+00
7.00E+00	1.00E+00
1.00E+01	1.00E+00
2.00E+01	1.00E+00
3.00E+01	1.00E+00
5.00E+01	1.00E+00
7.00E+01	8.99E-01
1.00E+02	7.17E-01
2.00E+02	1.86E-01
3.00E+02	6.76E-02
3.27E+02	6.76E-02

RESULT NAME = Source Term 1, Plume 1, at 0.6-3.2 KM
Plume Sigma-Z (m)

1.00E-05	9.98E-01
2.00E-05	9.98E-01
3.00E-05	9.98E-01
5.00E-05	9.98E-01
7.00E-05	9.98E-01
1.00E-04	9.98E-01
2.00E-04	9.98E-01
3.00E-04	9.98E-01
5.00E-04	9.98E-01
7.00E-04	9.98E-01
1.00E-03	9.98E-01
2.00E-03	9.98E-01
3.00E-03	9.98E-01
5.00E-03	9.98E-01
7.00E-03	9.98E-01
1.00E-02	9.98E-01
2.00E-02	9.98E-01
3.00E-02	9.98E-01
5.00E-02	9.98E-01
7.00E-02	9.98E-01
1.00E-01	9.98E-01
2.00E-01	9.98E-01
3.00E-01	9.98E-01
5.00E-01	9.98E-01
7.00E-01	9.98E-01
1.00E+00	9.98E-01
2.00E+00	9.98E-01
3.00E+00	9.98E-01
5.00E+00	9.98E-01
7.00E+00	9.98E-01
1.00E+01	9.98E-01
2.00E+01	9.98E-01
3.00E+01	8.97E-01
5.00E+01	8.97E-01
7.00E+01	3.94E-01
1.00E+02	3.94E-01
2.00E+02	1.84E-01
3.00E+02	1.84E-01
5.00E+02	1.84E-01
7.00E+02	6.54E-02
1.00E+03	6.54E-02
2.00E+03	6.54E-02
3.00E+03	6.54E-02
5.00E+03	6.54E-02
5.66E+03	6.54E-02

RESULT NAME = Source Term 1, Plume 1, at 0.6-3.2 KM
Plume Height (m)
0.00E+00 0.00E+00

RESULT NAME = Source Term 1, Plume 1, at 0.6-3.2 KM
Plume Arrival Time (s)

1.00E-04	1.00E+00
2.00E-04	1.00E+00
3.00E-04	1.00E+00
5.00E-04	1.00E+00
7.00E-04	1.00E+00
1.00E-03	1.00E+00
2.00E-03	1.00E+00
3.00E-03	1.00E+00
5.00E-03	1.00E+00
7.00E-03	1.00E+00
1.00E-02	1.00E+00
2.00E-02	1.00E+00
3.00E-02	1.00E+00
5.00E-02	1.00E+00
7.00E-02	1.00E+00
1.00E-01	1.00E+00
2.00E-01	1.00E+00
3.00E-01	1.00E+00
5.00E-01	1.00E+00
7.00E-01	1.00E+00
1.00E+00	1.00E+00
2.00E+00	1.00E+00
3.00E+00	1.00E+00
5.00E+00	1.00E+00
7.00E+00	1.00E+00
1.00E+01	1.00E+00
2.00E+01	1.00E+00
3.00E+01	1.00E+00
5.00E+01	1.00E+00
7.00E+01	1.00E+00
1.00E+02	1.00E+00
2.00E+02	9.60E-01
3.00E+02	9.15E-01
5.00E+02	6.13E-01
7.00E+02	4.51E-01
1.00E+03	1.82E-01
2.00E+03	6.85E-04
2.11E+03	6.85E-04

DATE AND TIME OF RUN = MACCS2 11/24/93 13:13:35 Fixed Noble Gas Omission: Version 1.02, 5/3/93
 "ATMOS" DESCRIPTION = WSNATM.INP, RFP METEOROLOGICAL DATA, EPA METHOD, NO WAKE EFFECTS
 "EARLY" DESCRIPTION = WSNEAR.INP, WIND-SHIFT WITHOUT ROTATION, 50-MILE POPULATION
 "CHRONC" DESCRIPTION = COLOCHRN.INP, NO PROT ACTIONS, COSTS, OR DECON, 50 YR EXPOSURE.

SOURCE TERM 1 OF 2:

1 g Pu, 10 min, ground-level release, RFP met data, no fire

OVERALL RESULTS OBTAINED BY COMBINING 1 EMERGENCY RESPONSE COHORTS FROM "EARLY" WITH THE WEIGHTING FRACTIONS BELOW APPLIED TO THEM:

FRACTION OF THE PEOPLE

1.000

COHORT 1 = NO EVACUATION

AND THEN MERGING THE 1 RESULTS ABOVE WITH THE SINGLE SET OF RESULTS FROM "CHRONC" DESCRIBED BELOW:

COHORT 2 = COLOCHRN.INP, NO PROT ACTIONS, COSTS, OR DECON, 50 YR EXPOSURE.

RESULTS WHICH ARE PRODUCED ONLY BY "EARLY" OR ONLY BY "CHRONC" ARE PRESENTED IN LATER SECTIONS.

11/24/93 13:13:35 PAGE 1	PROB	MEAN	50TH	QUANTILES	90TH	95TH	99TH	99.9TH	PEAK	PEAK	PEAK
	NON-ZERO								CONS	PROB	TRIAL
HEALTH EFFECTS CASES											
CAN FAT/TOTAL	0-80.5 KM	1.0000	2.32E-02	7.29E-03	5.73E-02	1.07E-01	1.97E-01	NOT-FOUND	3.93E-01	1.20E-03	88
CAN FAT/BONE	0-80.5 KM	1.0000	4.77E-04	1.67E-04	1.15E-03	2.18E-03	4.90E-03	NOT-FOUND	8.12E-03	1.20E-03	88
CAN FAT/LUNG	0-80.5 KM	1.0000	2.01E-02	7.00E-03	4.46E-02	9.56E-02	1.97E-01	NOT-FOUND	3.41E-01	1.20E-03	88
CAN FAT/LIVER	0-80.5 KM	1.0000	2.60E-03	9.07E-04	6.39E-03	1.23E-02	2.42E-02	NOT-FOUND	4.42E-02	1.20E-03	88
AVERAGE INDIVIDUAL RISK											
CAN FAT/TOTAL	0.6-3.2 KM	1.0000	5.26E-07	3.16E-07	1.24E-06	1.86E-06	3.06E-06	3.51E-06	3.68E-06	4.57E-04	26
POPULATION DOSE (SV)											
L-EDEWBODY TOT LIF	0-80.5 KM	1.0000	7.44E-01	2.67E-01	1.72E+00	3.50E+00	6.91E+00	NOT-FOUND	1.26E+01	1.20E-03	88
L-BONE SUR TOT LIF	0-80.5 KM	1.0000	7.95E+00	2.75E+00	1.78E+01	3.50E+01	6.91E+01	NOT-FOUND	1.35E+02	1.20E-03	88
L-LUNGS TOT LIF	0-80.5 KM	1.0000	2.52E+00	8.94E-01	5.73E+00	1.22E+01	2.41E+01	NOT-FOUND	4.26E+01	1.20E-03	88
L-LIVER TOT LIF	0-80.5 KM	1.0000	1.73E+00	6.05E-01	4.27E+00	7.79E+00	1.39E+01	NOT-FOUND	2.95E+01	1.20E-03	88
POPULATION WEIGHTED RISK											
CAN FAT/TOTAL	0-80.5 KM	1.0000	1.04E-08	3.45E-09	2.36E-08	4.70E-08	9.86E-08	NOT-FOUND	1.75E-07	1.20E-03	88
CAN FAT/TOTAL	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
CAN FAT/BONE	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
CAN FAT/LUNG	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
CAN FAT/LIVER	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
PEAK DOSE FOUND ON SPATIAL GRID (SV)											
L-EDEWBODY	0-0.2 KM	1.0000	8.60E-02	4.61E-02	2.17E-01	3.44E-01	5.20E-01	6.49E-01	7.59E-01	4.57E-04	26
L-EDEWBODY	0.2-0.6 KM	1.0000	8.10E-03	3.65E-03	2.17E-02	3.44E-02	5.20E-02	6.49E-02	7.51E-02	4.57E-04	26
L-EDEWBODY	0.6-3.2 KM	1.0000	7.14E-04	3.51E-04	2.11E-03	3.29E-03	5.14E-03	6.25E-03	6.69E-03	4.57E-04	26
L-EDEWBODY	3.2-4.8 KM	1.0000	1.93E-04	8.11E-05	5.42E-04	8.35E-04	1.08E-03	NOT-FOUND	1.27E-03	1.20E-03	54
L-EDEWBODY	4.8-6.4 KM	1.0000	1.02E-04	5.58E-05	2.53E-04	4.10E-04	NOT-FOUND	NOT-FOUND	5.95E-04	1.32E-02	39
L-EDEWBODY	6.4-8.0 KM	1.0000	6.55E-05	3.58E-05	1.75E-04	3.08E-04	NOT-FOUND	NOT-FOUND	3.65E-04	1.32E-02	69
L-EDEWBODY	8.0-16.1 KM	1.0000	3.02E-05	1.37E-05	6.70E-05	1.10E-04	NOT-FOUND	NOT-FOUND	1.85E-04	1.32E-02	69
L-EDEWBODY	16.1-32.2 KM	1.0000	7.41E-06	2.90E-06	1.64E-05	2.32E-05	NOT-FOUND	NOT-FOUND	3.96E-05	1.32E-02	69
L-EDEWBODY	32.2-48.3 KM	1.0000	2.86E-06	1.50E-06	5.94E-06	9.12E-06	2.04E-05	NOT-FOUND	2.26E-05	1.20E-03	88
L-EDEWBODY	48.3-64.4 KM	1.0000	1.69E-06	8.47E-07	3.56E-06	4.52E-06	9.02E-06	NOT-FOUND	2.78E-05	3.17E-03	72
L-EDEWBODY	64.4-80.5 KM	1.0000	1.17E-06	5.41E-07	2.77E-06	3.95E-06	5.96E-06	NOT-FOUND	8.37E-06	3.60E-03	87

11/24/93	13:13:35	PAGE	2	PROB		QUANTILES					PEAK	PEAK	PEAK
				NON-ZERO	MEAN	50TH	90TH	95TH	99TH	99.9TH	CONS	PROB	TRIAL
PEAK DOSE FOUND ON SPATIAL GRID (SV)													
L-BONE SUR	0-0.2 KM	1.0000	9.18E-01	4.73E-01	2.32E+00	3.88E+00	5.44E+00	6.57E+00	8.10E+00	4.57E-04	26		
L-BONE SUR	0.2-0.6 KM	1.0000	8.65E-02	4.00E-02	2.32E-01	3.88E-01	5.44E-01	6.57E-01	8.01E-01	4.57E-04	26		
L-BONE SUR	0.6-3.2 KM	1.0000	7.62E-03	3.53E-03	2.17E-02	3.44E-02	5.20E-02	6.49E-02	7.13E-02	4.57E-04	26		
L-BONE SUR	3.2-4.8 KM	1.0000	2.06E-03	9.00E-04	7.02E-03	9.24E-03	1.13E-02	NOT-FOUND	1.35E-02	1.20E-03	54		
L-BONE SUR	4.8-6.4 KM	1.0000	1.09E-03	5.60E-04	2.62E-03	4.96E-03	NOT-FOUND	NOT-FOUND	6.35E-03	1.32E-02	35		
L-BONE SUR	6.4-8.0 KM	1.0000	6.99E-04	3.58E-04	1.97E-03	3.11E-03	NOT-FOUND	NOT-FOUND	3.89E-03	1.32E-02	65		
L-BONE SUR	8.0-16.1 KM	1.0000	3.23E-04	1.39E-04	7.66E-04	1.11E-03	NOT-FOUND	NOT-FOUND	1.97E-03	1.32E-02	65		
L-BONE SUR	16.1-32.2 KM	1.0000	7.90E-05	3.15E-05	2.08E-04	2.84E-04	NOT-FOUND	NOT-FOUND	4.22E-04	1.32E-02	65		
L-BONE SUR	32.2-48.3 KM	1.0000	3.05E-05	1.77E-05	6.79E-05	9.56E-05	2.08E-04	NOT-FOUND	2.42E-04	1.20E-03	88		
L-BONE SUR	48.3-64.4 KM	1.0000	1.80E-05	9.07E-06	3.72E-05	5.02E-05	9.85E-05	NOT-FOUND	2.98E-04	3.17E-03	77		
L-BONE SUR	64.4-80.5 KM	1.0000	1.25E-05	6.26E-06	3.15E-05	4.21E-05	7.87E-05	NOT-FOUND	8.96E-05	3.60E-03	87		
L-LUNGS	0-0.2 KM	1.0000	2.92E-01	1.74E-01	7.52E-01	1.19E+00	2.05E+00	2.43E+00	2.58E+00	4.57E-04	26		
L-LUNGS	0.2-0.6 KM	1.0000	2.75E-02	1.16E-02	7.52E-02	1.19E-01	2.05E-01	2.41E-01	2.55E-01	4.57E-04	26		
L-LUNGS	0.6-3.2 KM	1.0000	2.42E-03	1.12E-03	7.34E-03	1.04E-02	1.30E-02	1.79E-02	2.27E-02	4.57E-04	26		
L-LUNGS	3.2-4.8 KM	1.0000	6.56E-04	3.02E-04	2.01E-03	3.02E-03	3.52E-03	NOT-FOUND	4.30E-03	1.20E-03	54		
L-LUNGS	4.8-6.4 KM	1.0000	3.46E-04	1.51E-04	8.60E-04	1.19E-03	NOT-FOUND	NOT-FOUND	2.02E-03	1.32E-02	35		
L-LUNGS	6.4-8.0 KM	1.0000	2.22E-04	1.16E-04	5.29E-04	1.03E-03	NOT-FOUND	NOT-FOUND	1.24E-03	1.32E-02	65		
L-LUNGS	8.0-16.1 KM	1.0000	1.03E-04	5.28E-05	2.35E-04	5.15E-04	NOT-FOUND	NOT-FOUND	6.28E-04	1.32E-02	65		
L-LUNGS	16.1-32.2 KM	1.0000	2.51E-05	9.70E-06	5.70E-05	7.96E-05	NOT-FOUND	NOT-FOUND	1.34E-04	1.32E-02	65		
L-LUNGS	32.2-48.3 KM	1.0000	9.70E-06	5.50E-06	2.13E-05	2.99E-05	5.64E-05	NOT-FOUND	7.61E-05	1.20E-03	88		
L-LUNGS	48.3-64.4 KM	1.0000	5.71E-06	2.75E-06	1.26E-05	1.73E-05	2.95E-05	NOT-FOUND	9.35E-05	3.17E-03	77		
L-LUNGS	64.4-80.5 KM	1.0000	3.95E-06	1.90E-06	9.34E-06	1.37E-05	2.36E-05	NOT-FOUND	2.82E-05	3.60E-03	87		
L-LIVER	0-0.2 KM	1.0000	2.00E-01	9.69E-02	5.23E-01	7.87E-01	1.15E+00	1.58E+00	1.76E+00	4.57E-04	26		
L-LIVER	0.2-0.6 KM	1.0000	1.88E-02	8.17E-03	5.35E-02	8.17E-02	1.15E-01	1.57E-01	1.74E-01	4.57E-04	26		
L-LIVER	0.6-3.2 KM	1.0000	1.66E-03	7.87E-04	5.23E-03	7.87E-03	1.12E-02	1.43E-02	1.55E-02	4.57E-04	26		
L-LIVER	3.2-4.8 KM	1.0000	4.49E-04	2.02E-04	1.19E-03	2.05E-03	2.40E-03	NOT-FOUND	2.94E-03	1.20E-03	54		
L-LIVER	4.8-6.4 KM	1.0000	2.37E-04	1.16E-04	5.91E-04	1.04E-03	NOT-FOUND	NOT-FOUND	1.38E-03	1.32E-02	35		
L-LIVER	6.4-8.0 KM	1.0000	1.52E-04	7.94E-05	3.89E-04	7.18E-04	NOT-FOUND	NOT-FOUND	8.47E-04	1.32E-02	65		
L-LIVER	8.0-16.1 KM	1.0000	7.02E-05	3.30E-05	1.68E-04	3.17E-04	NOT-FOUND	NOT-FOUND	4.30E-04	1.32E-02	65		
L-LIVER	16.1-32.2 KM	1.0000	1.72E-05	6.73E-06	4.11E-05	5.64E-05	NOT-FOUND	NOT-FOUND	9.19E-05	1.32E-02	65		
L-LIVER	32.2-48.3 KM	1.0000	6.65E-06	3.53E-06	1.53E-05	2.45E-05	3.67E-05	NOT-FOUND	5.27E-05	1.20E-03	88		
L-LIVER	48.3-64.4 KM	1.0000	3.92E-06	1.84E-06	8.43E-06	1.18E-05	2.37E-05	NOT-FOUND	6.48E-05	3.17E-03	77		
L-LIVER	64.4-80.5 KM	1.0000	2.71E-06	1.39E-06	6.55E-06	8.96E-06	1.46E-05	NOT-FOUND	1.95E-05	3.60E-03	87		

DATE AND TIME OF RUN = MACCS2 11/24/93 13:13:35 Fixed Noble Gas Omission: Version 1.02, 5/3/93
 "ATMOS" DESCRIPTION = WSNATH.INP, RFP METEOROLOGICAL DATA, EPA METHOD, NO WAKE EFFECTS
 "EARLY" DESCRIPTION = WSNEAR.INP, WIND-SHIFT WITHOUT ROTATION, 50-MILE POPULATION

SOURCE TERM 1 OF 2:

1 g Pu, 10 min, ground-level release, RFP met data, no fire

RESULTS FOR A SINGLE EMERGENCY RESPONSE COHORT WITHOUT ANY WEIGHTING FRACTIONS BEING APPLIED

COHORT 1 = NO EVACUATION

11/24/93 13:13:35	PAGE 3	PROB	QUANTILES						PEAK	PEAK	PEAK
		NON-ZERO	MEAN	50TH	90TH	95TH	99TH	99.9TH	CONS	PROB	TRIAL
HEALTH EFFECTS CASES											
CAN FAT/TOTAL	0-80.5 KM	1.0000	1.63E-02	6.00E-03	4.12E-02	7.33E-02	NOT-FOUND	NOT-FOUND	1.49E-01	1.16E-02	25
CAN FAT/BONE	0-80.5 KM	1.0000	3.34E-04	1.26E-04	8.53E-04	1.50E-03	NOT-FOUND	NOT-FOUND	3.05E-03	1.16E-02	25
CAN FAT/LUNG	0-80.5 KM	1.0000	1.42E-02	4.90E-03	3.75E-02	7.09E-02	NOT-FOUND	NOT-FOUND	1.29E-01	1.16E-02	25
CAN FAT/LIVER	0-80.5 KM	1.0000	1.82E-03	6.71E-04	4.12E-03	8.16E-03	NOT-FOUND	NOT-FOUND	1.66E-02	1.16E-02	25
EARLY FATALITY DISTANCE (KM)											
ERL FAT/TOTAL RISK > 0.000		0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
POPULATION EXCEEDING DOSE											
EARLY dose to L-EDEWBODY > 0.050 SV		0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
AVERAGE INDIVIDUAL RISK											
CAN FAT/TOTAL	0.6-3.2 KM	1.0000	4.09E-07	2.35E-07	1.02E-06	1.31E-06	2.09E-06	2.71E-06	2.96E-06	4.57E-04	26
ERL FAT/TOTAL	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
POPULATION DOSE (SV)											
L-EDEWBODY TOT LIF	0-80.5 KM	1.0000	5.23E-01	1.89E-01	1.38E+00	2.38E+00	NOT-FOUND	NOT-FOUND	4.76E+00	1.16E-02	25
L-BONE SUR TOT LIF	0-80.5 KM	1.0000	5.57E+00	1.95E+00	1.38E+01	2.38E+01	NOT-FOUND	NOT-FOUND	5.08E+01	1.16E-02	25
L-LUNGS TOT LIF	0-80.5 KM	1.0000	1.77E+00	6.65E-01	4.12E+00	8.16E+00	NOT-FOUND	NOT-FOUND	1.62E+01	1.16E-02	25
L-LIVER TOT LIF	0-80.5 KM	1.0000	1.21E+00	4.66E-01	3.07E+00	5.78E+00	NOT-FOUND	NOT-FOUND	1.11E+01	1.16E-02	25
POPULATION WEIGHTED RISK											
CAN FAT/TOTAL	0-80.5 KM	1.0000	7.29E-09	2.81E-09	1.68E-08	3.25E-08	NOT-FOUND	NOT-FOUND	6.65E-08	1.16E-02	25
CAN FAT/TOTAL	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
CAN FAT/BONE	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
CAN FAT/LUNG	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
CAN FAT/LIVER	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
PEAK DOSE FOUND ON SPATIAL GRID (SV)											
L-EDEWBODY	0-0.2 KM	1.0000	7.75E-02	4.04E-02	2.11E-01	3.29E-01	5.16E-01	6.48E-01	7.06E-01	4.57E-04	26
L-EDEWBODY	0.2-0.6 KM	1.0000	7.37E-03	3.51E-03	2.11E-02	3.29E-02	5.16E-02	6.48E-02	7.03E-02	4.57E-04	26
L-EDEWBODY	0.6-3.2 KM	1.0000	6.54E-04	2.48E-04	2.08E-03	3.10E-03	5.11E-03	5.99E-03	6.32E-03	4.57E-04	26
L-EDEWBODY	3.2-4.8 KM	1.0000	1.76E-04	7.58E-05	5.10E-04	8.35E-04	1.06E-03	NOT-FOUND	1.20E-03	1.20E-03	54
L-EDEWBODY	4.8-6.4 KM	1.0000	9.23E-05	3.88E-05	2.33E-04	3.65E-04	NOT-FOUND	NOT-FOUND	5.64E-04	1.32E-02	35
L-EDEWBODY	6.4-8.0 KM	1.0000	5.92E-05	3.33E-05	1.50E-04	2.53E-04	NOT-FOUND	NOT-FOUND	3.46E-04	1.32E-02	65
L-EDEWBODY	8.0-16.1 KM	1.0000	2.74E-05	1.27E-05	6.44E-05	1.08E-04	NOT-FOUND	NOT-FOUND	1.76E-04	1.32E-02	65
L-EDEWBODY	16.1-32.2 KM	1.0000	6.45E-06	2.70E-06	1.51E-05	2.05E-05	NOT-FOUND	NOT-FOUND	3.74E-05	1.32E-02	65
L-EDEWBODY	32.2-48.3 KM	1.0000	2.40E-06	1.18E-06	5.33E-06	6.73E-06	NOT-FOUND	NOT-FOUND	1.93E-05	1.30E-02	72
L-EDEWBODY	48.3-64.4 KM	1.0000	1.36E-06	6.97E-07	3.14E-06	3.88E-06	NOT-FOUND	NOT-FOUND	8.29E-06	1.32E-02	65
L-EDEWBODY	64.4-80.5 KM	1.0000	9.45E-07	4.67E-07	2.24E-06	2.92E-06	NOT-FOUND	NOT-FOUND	6.35E-06	1.32E-02	65
L-BONE SUR	0-0.2 KM	1.0000	8.27E-01	4.49E-01	2.11E+00	3.30E+00	5.20E+00	6.49E+00	7.53E+00	4.57E-04	26
L-BONE SUR	0.2-0.6 KM	1.0000	7.85E-02	3.51E-02	2.17E-01	3.44E-01	5.20E-01	6.49E-01	7.49E-01	4.57E-04	26

11/24/93	13:13:35	PAGE	4	PROB		QUANTILES				PEAK	PEAK	PEAK	
				NON-ZERO	MEAN	50TH	90TH	95TH	99TH	99.9TH	CONS	PROB	TRIAL
PEAK DOSE FOUND ON SPATIAL GRID (SV)													
L-BONE SUR	0.6-3.2 KM	1.0000	6.98E-03	2.88E-03	2.11E-02	3.29E-02	5.14E-02	6.29E-02	6.74E-02	4.57E-04	26		
L-BONE SUR	3.2-4.8 KM	1.0000	1.88E-03	7.67E-04	5.12E-03	8.35E-03	1.08E-02	NOT-FOUND	1.28E-02	1.20E-03	54		
L-BONE SUR	4.8-6.4 KM	1.0000	9.84E-04	4.79E-04	2.44E-03	4.06E-03	NOT-FOUND	NOT-FOUND	6.01E-03	1.32E-02	35		
L-BONE SUR	6.4-8.0 KM	1.0000	6.31E-04	3.35E-04	1.70E-03	3.08E-03	NOT-FOUND	NOT-FOUND	3.69E-03	1.32E-02	65		
L-BONE SUR	8.0-16.1 KM	1.0000	2.92E-04	1.28E-04	6.59E-04	1.09E-03	NOT-FOUND	NOT-FOUND	1.87E-03	1.32E-02	65		
L-BONE SUR	16.1-32.2 KM	1.0000	6.88E-05	2.78E-05	1.56E-04	2.11E-04	NOT-FOUND	NOT-FOUND	3.99E-04	1.32E-02	65		
L-BONE SUR	32.2-48.3 KM	1.0000	2.56E-05	1.25E-05	5.47E-05	7.07E-05	NOT-FOUND	NOT-FOUND	2.05E-04	1.30E-02	72		
L-BONE SUR	48.3-64.4 KM	1.0000	1.45E-05	7.40E-06	3.29E-05	3.98E-05	NOT-FOUND	NOT-FOUND	8.84E-05	1.32E-02	65		
L-BONE SUR	64.4-80.5 KM	1.0000	1.01E-05	4.92E-06	2.33E-05	3.19E-05	NOT-FOUND	NOT-FOUND	6.77E-05	1.32E-02	65		
L-LUNGS	0-0.2 KM	1.0000	2.63E-01	1.27E-01	7.34E-01	1.04E+00	1.30E+00	1.79E+00	2.40E+00	4.57E-04	26		
L-LUNGS	0.2-0.6 KM	1.0000	2.50E-02	1.11E-02	7.34E-02	1.04E-01	1.30E-01	1.79E-01	2.39E-01	4.57E-04	26		
L-LUNGS	0.6-3.2 KM	1.0000	2.22E-03	8.64E-04	7.04E-03	1.01E-02	1.28E-02	1.79E-02	2.15E-02	4.57E-04	26		
L-LUNGS	3.2-4.8 KM	1.0000	5.98E-04	2.39E-04	2.01E-03	2.74E-03	3.39E-03	NOT-FOUND	4.07E-03	1.20E-03	54		
L-LUNGS	4.8-6.4 KM	1.0000	3.13E-04	1.40E-04	8.01E-04	1.16E-03	NOT-FOUND	NOT-FOUND	1.91E-03	1.32E-02	35		
L-LUNGS	6.4-8.0 KM	1.0000	2.01E-04	1.09E-04	4.79E-04	8.61E-04	NOT-FOUND	NOT-FOUND	1.17E-03	1.32E-02	65		
L-LUNGS	8.0-16.1 KM	1.0000	9.30E-05	3.86E-05	2.14E-04	4.92E-04	NOT-FOUND	NOT-FOUND	5.97E-04	1.32E-02	65		
L-LUNGS	16.1-32.2 KM	1.0000	2.19E-05	9.11E-06	5.21E-05	7.14E-05	NOT-FOUND	NOT-FOUND	1.27E-04	1.32E-02	65		
L-LUNGS	32.2-48.3 KM	1.0000	8.15E-06	4.03E-06	1.68E-05	2.33E-05	NOT-FOUND	NOT-FOUND	6.54E-05	1.30E-02	72		
L-LUNGS	48.3-64.4 KM	1.0000	4.62E-06	2.44E-06	1.12E-05	1.42E-05	NOT-FOUND	NOT-FOUND	2.81E-05	1.32E-02	65		
L-LUNGS	64.4-80.5 KM	1.0000	3.21E-06	1.72E-06	7.72E-06	9.77E-06	NOT-FOUND	NOT-FOUND	2.16E-05	1.32E-02	65		
L-LIVER	0-0.2 KM	1.0000	1.80E-01	9.30E-02	5.23E-01	7.87E-01	1.13E+00	1.49E+00	1.64E+00	4.57E-04	26		
L-LIVER	0.2-0.6 KM	1.0000	1.71E-02	7.71E-03	5.04E-02	7.87E-02	1.13E-01	1.49E-01	1.63E-01	4.57E-04	26		
L-LIVER	0.6-3.2 KM	1.0000	1.52E-03	5.56E-04	5.03E-03	7.17E-03	1.04E-02	1.35E-02	1.47E-02	4.57E-04	26		
L-LIVER	3.2-4.8 KM	1.0000	4.09E-04	1.52E-04	1.03E-03	2.01E-03	2.31E-03	NOT-FOUND	2.78E-03	1.20E-03	54		
L-LIVER	4.8-6.4 KM	1.0000	2.14E-04	1.09E-04	5.36E-04	1.04E-03	NOT-FOUND	NOT-FOUND	1.31E-03	1.32E-02	35		
L-LIVER	6.4-8.0 KM	1.0000	1.37E-04	7.56E-05	3.48E-04	6.08E-04	NOT-FOUND	NOT-FOUND	8.03E-04	1.32E-02	65		
L-LIVER	8.0-16.1 KM	1.0000	6.36E-05	3.09E-05	1.44E-04	3.13E-04	NOT-FOUND	NOT-FOUND	4.08E-04	1.32E-02	65		
L-LIVER	16.1-32.2 KM	1.0000	1.50E-05	6.37E-06	3.82E-05	5.09E-05	NOT-FOUND	NOT-FOUND	8.70E-05	1.32E-02	65		
L-LIVER	32.2-48.3 KM	1.0000	5.57E-06	3.14E-06	1.18E-05	1.55E-05	NOT-FOUND	NOT-FOUND	4.47E-05	1.30E-02	72		
L-LIVER	48.3-64.4 KM	1.0000	3.16E-06	1.72E-06	7.33E-06	8.99E-06	NOT-FOUND	NOT-FOUND	1.92E-05	1.32E-02	65		
L-LIVER	64.4-80.5 KM	1.0000	2.19E-06	1.20E-06	5.48E-06	6.85E-06	NOT-FOUND	NOT-FOUND	1.48E-05	1.32E-02	65		

DATE AND TIME OF RUN = MACCS2 11/24/93 13:13:35 Fixed Noble Gas Omission: Version 1.02, 5/3/93
 "ATMOS" DESCRIPTION = WSNATM.INP, RFP METEOROLOGICAL DATA, EPA METHOD, NO WAKE EFFECTS
 "EARLY" DESCRIPTION = WSNEAR.INP, WIND-SHIFT WITHOUT ROTATION, 50-MILE POPULATION
 "CHRONC" DESCRIPTION = COLOCHRN.INP, NO PROT ACTIONS, COSTS, OR DECON, 50 YR EXPOSURE.

SOURCE TERM 1 OF 2:

1 g Pu, 10 min, ground-level release, RFP met data, no fire

RESULTS FROM THE "CHRONC" MODULE ALONE

COHORT 2 = COLOCHRN.INP, NO PROT ACTIONS, COSTS, OR DECON, 50 YR EXPOSURE.

11/24/93 13:13:35	PAGE 5	PROB	MEAN	50TH	QUANTILES	90TH	95TH	99TH	99.9TH	PEAK	PEAK	PEAK
		NON-ZERO								CONS	PROB	TRIAL
HEALTH EFFECTS CASES												
CAN FAT/TOTAL	0-80.5 KM	1.0000	6.87E-03	1.77E-03	1.41E-02	2.55E-02	1.11E-01	NOT-FOUND	2.67E-01	1.20E-03	88	
CAN FAT/BONE	0-80.5 KM	1.0000	1.43E-04	3.53E-05	2.79E-04	5.80E-04	3.07E-03	NOT-FOUND	5.54E-03	1.20E-03	88	
CAN FAT/LUNG	0-80.5 KM	1.0000	5.95E-03	1.55E-03	1.03E-02	2.39E-02	1.03E-01	NOT-FOUND	2.31E-01	1.20E-03	88	
CAN FAT/LIVER	0-80.5 KM	1.0000	7.77E-04	2.01E-04	1.47E-03	2.56E-03	1.19E-02	NOT-FOUND	3.01E-02	1.20E-03	88	
AVERAGE INDIVIDUAL RISK												
CAN FAT/TOTAL	0.6-3.2 KM	1.0000	1.17E-07	5.95E-08	3.10E-07	4.11E-07	7.44E-07	NOT-FOUND	1.52E-06	2.94E-03	22	
POPULATION DOSE (SV)												
L-EDEWBODY TOT LIF	0-80.5 KM	1.0000	2.22E-01	5.48E-02	4.43E-01	8.19E-01	5.07E+00	NOT-FOUND	8.59E+00	1.20E-03	88	
L-BONE SUR TOT LIF	0-80.5 KM	1.0000	2.38E+00	5.89E-01	4.74E+00	8.65E+00	5.07E+01	NOT-FOUND	9.23E+01	1.20E-03	88	
L-LUNGS TOT LIF	0-80.5 KM	1.0000	7.44E-01	2.00E-01	1.47E+00	2.56E+00	1.19E+01	NOT-FOUND	2.89E+01	1.20E-03	88	
L-LIVER TOT LIF	0-80.5 KM	1.0000	5.18E-01	1.30E-01	9.56E-01	1.60E+00	1.01E+01	NOT-FOUND	2.01E+01	1.20E-03	88	
POPULATION WEIGHTED RISK												
CAN FAT/TOTAL	0-80.5 KM	1.0000	3.06E-09	7.72E-10	5.38E-09	1.13E-08	7.11E-08	NOT-FOUND	1.19E-07	1.20E-03	88	
CAN FAT/TOTAL	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
CAN FAT/BONE	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
CAN FAT/LUNG	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
CAN FAT/LIVER	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0	
PEAK DOSE FOUND ON SPATIAL GRID (SV)												
L-EDEWBODY	0-0.2 KM	1.0000	8.47E-03	6.17E-03	2.01E-02	2.50E-02	3.41E-02	4.54E-02	5.29E-02	4.57E-04	26	
L-EDEWBODY	0.2-0.6 KM	1.0000	7.38E-04	4.53E-04	1.73E-03	2.52E-03	3.43E-03	4.40E-03	4.79E-03	4.57E-04	26	
L-EDEWBODY	0.6-3.2 KM	1.0000	5.98E-05	3.41E-05	1.42E-04	2.23E-04	4.17E-04	NOT-FOUND	7.82E-04	2.94E-03	22	
L-EDEWBODY	3.2-4.8 KM	1.0000	1.72E-05	8.18E-06	4.24E-05	5.77E-05	1.39E-04	NOT-FOUND	3.08E-04	2.94E-03	22	
L-EDEWBODY	4.8-6.4 KM	1.0000	9.58E-06	4.48E-06	2.09E-05	2.87E-05	8.82E-05	NOT-FOUND	1.92E-04	2.94E-03	22	
L-EDEWBODY	6.4-8.0 KM	1.0000	6.30E-06	3.42E-06	1.19E-05	1.71E-05	6.49E-05	NOT-FOUND	1.27E-04	2.94E-03	83	
L-EDEWBODY	8.0-16.1 KM	1.0000	2.85E-06	1.26E-06	6.98E-06	8.70E-06	3.09E-05	6.47E-05	1.08E-04	7.42E-04	15	
L-EDEWBODY	16.1-32.2 KM	1.0000	9.55E-07	2.89E-07	1.59E-06	3.53E-06	1.29E-05	2.91E-05	3.01E-05	8.85E-04	17	
L-EDEWBODY	32.2-48.3 KM	1.0000	4.61E-07	1.23E-07	4.86E-07	1.86E-06	8.05E-06	NOT-FOUND	1.60E-05	1.34E-03	31	
L-EDEWBODY	48.3-64.4 KM	1.0000	3.25E-07	8.07E-08	2.68E-07	8.30E-07	6.53E-06	NOT-FOUND	2.20E-05	3.17E-03	77	
L-EDEWBODY	64.4-80.5 KM	1.0000	2.22E-07	5.38E-08	1.75E-07	7.67E-07	4.24E-06	NOT-FOUND	5.57E-06	3.60E-03	87	
L-BONE SUR	0-0.2 KM	1.0000	9.09E-02	6.51E-02	2.01E-01	2.75E-01	3.52E-01	4.57E-01	5.68E-01	4.57E-04	26	
L-BONE SUR	0.2-0.6 KM	1.0000	7.93E-03	4.58E-03	2.06E-02	2.62E-02	3.94E-02	5.09E-02	5.14E-02	4.57E-04	26	
L-BONE SUR	0.6-3.2 KM	1.0000	6.42E-04	3.58E-04	1.63E-03	2.37E-03	4.17E-03	NOT-FOUND	8.40E-03	2.94E-03	22	
L-BONE SUR	3.2-4.8 KM	1.0000	1.84E-04	8.31E-05	4.78E-04	6.38E-04	1.44E-03	NOT-FOUND	3.30E-03	2.94E-03	22	
L-BONE SUR	4.8-6.4 KM	1.0000	1.03E-04	5.12E-05	2.15E-04	3.42E-04	9.13E-04	NOT-FOUND	2.06E-03	2.94E-03	22	
L-BONE SUR	6.4-8.0 KM	1.0000	6.76E-05	3.42E-05	1.32E-04	2.02E-04	6.85E-04	NOT-FOUND	1.36E-03	2.94E-03	83	
L-BONE SUR	8.0-16.1 KM	1.0000	3.06E-05	1.40E-05	7.00E-05	8.70E-05	3.11E-04	6.56E-04	1.16E-03	7.42E-04	15	

11/24/93	13:13:35	PAGE	6	PROB	QUANTILES					PEAK	PEAK	PEAK	
				NON-ZERO	MEAN	50TH	90TH	95TH	99TH	99.9TH	CONS	PROB	TRIAL
PEAK DOSE FOUND ON SPATIAL GRID (SV)													
L-BONE SUR	16.1-32.2 KM	1.0000	1.03E-05	2.90E-06	1.77E-05	4.23E-05	1.43E-04	2.92E-04	3.23E-04	8.85E-04	17		
L-BONE SUR	32.2-48.3 KM	1.0000	4.95E-06	1.49E-06	4.97E-06	1.95E-05	8.05E-05	NOT-FOUND	1.71E-04	1.34E-03	31		
L-BONE SUR	48.3-64.4 KM	1.0000	3.49E-06	8.85E-07	2.92E-06	8.53E-06	6.73E-05	NOT-FOUND	2.36E-04	3.17E-03	77		
L-BONE SUR	64.4-80.5 KM	1.0000	2.38E-06	5.64E-07	2.05E-06	9.04E-06	4.27E-05	NOT-FOUND	5.98E-05	3.60E-03	87		
L-LUNGS	0-0.2 KM	1.0000	2.85E-02	2.01E-02	6.36E-02	8.37E-02	1.16E-01	1.59E-01	1.78E-01	4.57E-04	26		
L-LUNGS	0.2-0.6 KM	1.0000	2.48E-03	1.50E-03	5.80E-03	8.39E-03	1.14E-02	1.48E-02	1.61E-02	4.57E-04	26		
L-LUNGS	0.6-3.2 KM	1.0000	2.01E-04	1.11E-04	5.33E-04	6.81E-04	1.56E-03	NOT-FOUND	2.63E-03	2.94E-03	22		
L-LUNGS	3.2-4.8 KM	1.0000	5.77E-05	2.82E-05	1.23E-04	1.76E-04	5.19E-04	NOT-FOUND	1.03E-03	2.94E-03	22		
L-LUNGS	4.8-6.4 KM	1.0000	3.22E-05	1.52E-05	7.29E-05	9.61E-05	2.82E-04	NOT-FOUND	6.45E-04	2.94E-03	22		
L-LUNGS	6.4-8.0 KM	1.0000	2.12E-05	1.08E-05	4.94E-05	6.33E-05	2.18E-04	NOT-FOUND	4.26E-04	2.94E-03	83		
L-LUNGS	8.0-16.1 KM	1.0000	9.59E-06	3.86E-06	2.11E-05	2.87E-05	1.02E-04	1.85E-04	3.62E-04	7.42E-04	15		
L-LUNGS	16.1-32.2 KM	1.0000	3.21E-06	9.68E-07	4.87E-06	1.10E-05	4.57E-05	9.72E-05	1.01E-04	8.85E-04	17		
L-LUNGS	32.2-48.3 KM	1.0000	1.55E-06	4.84E-07	1.72E-06	6.40E-06	2.73E-05	NOT-FOUND	5.37E-05	1.34E-03	31		
L-LUNGS	48.3-64.4 KM	1.0000	1.09E-06	3.04E-07	8.96E-07	2.50E-06	1.93E-05	NOT-FOUND	7.39E-05	3.17E-03	77		
L-LUNGS	64.4-80.5 KM	1.0000	7.46E-07	1.83E-07	6.39E-07	2.74E-06	1.32E-05	NOT-FOUND	1.87E-05	3.60E-03	87		
L-LIVER	0-0.2 KM	1.0000	1.98E-02	1.36E-02	4.17E-02	5.79E-02	1.02E-01	1.18E-01	1.24E-01	4.57E-04	26		
L-LIVER	0.2-0.6 KM	1.0000	1.73E-03	1.05E-03	3.85E-03	5.66E-03	8.46E-03	1.07E-02	1.12E-02	4.57E-04	26		
L-LIVER	0.6-3.2 KM	1.0000	1.40E-04	7.82E-05	3.46E-04	4.82E-04	8.81E-04	NOT-FOUND	1.83E-03	2.94E-03	22		
L-LIVER	3.2-4.8 KM	1.0000	4.02E-05	1.86E-05	1.04E-04	1.36E-04	3.50E-04	NOT-FOUND	7.20E-04	2.94E-03	22		
L-LIVER	4.8-6.4 KM	1.0000	2.24E-05	1.10E-05	4.97E-05	6.71E-05	1.85E-04	NOT-FOUND	4.49E-04	2.94E-03	22		
L-LIVER	6.4-8.0 KM	1.0000	1.47E-05	7.90E-06	3.30E-05	4.42E-05	1.45E-04	NOT-FOUND	2.97E-04	2.94E-03	83		
L-LIVER	8.0-16.1 KM	1.0000	6.67E-06	3.19E-06	1.23E-05	1.88E-05	7.38E-05	1.82E-04	2.52E-04	7.42E-04	15		
L-LIVER	16.1-32.2 KM	1.0000	2.23E-06	6.79E-07	3.57E-06	1.02E-05	2.92E-05	6.82E-05	7.04E-05	8.85E-04	17		
L-LIVER	32.2-48.3 KM	1.0000	1.08E-06	3.16E-07	1.48E-06	4.01E-06	1.82E-05	NOT-FOUND	3.73E-05	1.34E-03	31		
L-LIVER	48.3-64.4 KM	1.0000	7.60E-07	2.03E-07	6.31E-07	2.07E-06	1.47E-05	NOT-FOUND	5.14E-05	3.17E-03	77		
L-LIVER	64.4-80.5 KM	1.0000	5.19E-07	1.13E-07	4.35E-07	1.92E-06	9.76E-06	NOT-FOUND	1.30E-05	3.60E-03	87		
L-EDEWBODY POP. DOSE (SV) 0-80.5 KM													
TOTAL LONG-TERM PATHWAYS DOSE		1.0000	2.22E-01	5.48E-02	4.43E-01	8.19E-01	5.07E+00	NOT-FOUND	8.59E+00	1.20E-03	88		
LONG-TERM DIRECT EXPOSURE PATHWAYS		1.0000	2.21E-01	5.48E-02	4.43E-01	8.19E-01	5.07E+00	NOT-FOUND	8.59E+00	1.20E-03	88		
TOTAL INGESTION PATHWAYS DOSE		1.0000	1.97E-04	6.36E-05	3.37E-04	9.28E-04	NOT-FOUND	NOT-FOUND	3.29E-03	1.16E-02	40		
LONG-TERM GROUNDSHINE DOSE		1.0000	3.85E-05	1.00E-05	6.76E-05	1.52E-04	7.19E-04	NOT-FOUND	1.49E-03	1.20E-03	88		
LONG-TERM RESUSPENSION DOSE		1.0000	2.21E-01	5.48E-02	4.43E-01	8.19E-01	5.07E+00	NOT-FOUND	8.59E+00	1.20E-03	88		
POP. DEPENDENT DECONTAMINATION DOSE		0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0		
AREA DEPENDENT DECONTAMINATION DOSE		0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0		
GROWING SEASON MILK DOSE		1.0000	4.81E-08	1.94E-09	9.16E-08	2.71E-07	NOT-FOUND	NOT-FOUND	1.22E-06	1.16E-02	40		
GROWING SEASON CROP DOSE		1.0000	8.20E-05	4.15E-06	1.19E-04	4.06E-04	NOT-FOUND	NOT-FOUND	2.12E-03	1.16E-02	40		
LONG-TERM MILK DOSE		1.0000	1.22E-08	7.21E-09	2.62E-08	3.98E-08	8.58E-08	NOT-FOUND	2.08E-07	2.94E-03	22		
LONG-TERM CROP DOSE		1.0000	5.19E-05	1.20E-05	8.26E-05	2.57E-04	NOT-FOUND	NOT-FOUND	1.08E-03	1.16E-02	40		
WATER INGESTION DOSE		1.0000	6.33E-05	3.11E-05	1.35E-04	2.66E-04	5.09E-04	NOT-FOUND	6.21E-04	3.17E-03	77		
INDIVIDUAL FOOD DOSE (SV)													
IRAD = 3 IDIR = 6 : 1 y EXP		0.1832	3.51E-09	0.00E+00	3.18E-09	6.92E-09	1.12E-07	1.51E-07	6.46E-07	1.14E-04	26		
IRAD = 3 IDIR = 6 : 2 y EXP		0.1832	3.85E-09	0.00E+00	5.41E-09	9.67E-09	1.12E-07	1.51E-07	6.91E-07	1.14E-04	26		
IRAD = 3 IDIR = 6 : 5 y EXP		0.1832	4.15E-09	0.00E+00	6.38E-09	1.92E-08	1.12E-07	1.51E-07	7.14E-07	1.14E-04	26		
IRAD = 3 IDIR = 6 50 y EXP		0.1832	4.33E-09	0.00E+00	6.50E-09	1.92E-08	1.12E-07	1.51E-07	7.29E-07	1.14E-04	26		
POPULATION EXCEEDING FOOD INGESTION DOSE													
0.00E+00(SV) FOR YEAR 1		1.0000	2.36E+05	1.34E+05	7.48E+05	8.84E+05	1.11E+06	1.39E+06	1.43E+06	7.42E-04	3		
0.00E+00(SV) FOR YEAR 8		1.0000	2.36E+05	1.34E+05	7.48E+05	8.84E+05	1.11E+06	1.39E+06	1.43E+06	7.42E-04	3		
1.00E+00(SV) FOR YEAR 1		0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0		

SOURCE TERM 1 OF 2:

1 g Pu, 10 min, ground-level release, RFP met data, no fire

RESULT NAME = POPULATION DOSE (SV)

L-EDEWBODY TOT LIF

0-80.5 KM

PEOPLE FRACTION = 1.0000

OVERALL		EMER. RESP. # 1		CHRONC RESULTS	
X	PROB>=X	X	PROB>=X	X	PROB>=X
1.00E-06	1.00E+00	1.00E-06	1.00E+00	1.00E-06	1.00E+00
2.00E-06	1.00E+00	2.00E-06	1.00E+00	2.00E-06	1.00E+00
3.00E-06	1.00E+00	3.00E-06	1.00E+00	3.00E-06	1.00E+00
5.00E-06	1.00E+00	5.00E-06	1.00E+00	5.00E-06	1.00E+00
7.00E-06	1.00E+00	7.00E-06	1.00E+00	7.00E-06	1.00E+00
1.00E-05	1.00E+00	1.00E-05	1.00E+00	1.00E-05	1.00E+00
2.00E-05	1.00E+00	2.00E-05	1.00E+00	2.00E-05	1.00E+00
3.00E-05	1.00E+00	3.00E-05	1.00E+00	3.00E-05	1.00E+00
5.00E-05	1.00E+00	5.00E-05	1.00E+00	5.00E-05	1.00E+00
7.00E-05	1.00E+00	7.00E-05	1.00E+00	7.00E-05	1.00E+00
1.00E-04	1.00E+00	1.00E-04	1.00E+00	1.00E-04	1.00E+00
2.00E-04	1.00E+00	2.00E-04	1.00E+00	2.00E-04	1.00E+00
3.00E-04	1.00E+00	3.00E-04	1.00E+00	3.00E-04	1.00E+00
5.00E-04	1.00E+00	5.00E-04	1.00E+00	5.00E-04	1.00E+00
7.00E-04	1.00E+00	7.00E-04	1.00E+00	7.00E-04	9.91E-01
1.00E-03	1.00E+00	1.00E-03	1.00E+00	1.00E-03	9.81E-01
2.00E-03	1.00E+00	2.00E-03	1.00E+00	2.00E-03	9.37E-01
3.00E-03	9.91E-01	3.00E-03	9.89E-01	3.00E-03	9.31E-01
5.00E-03	9.81E-01	5.00E-03	9.26E-01	5.00E-03	8.82E-01
7.00E-03	9.35E-01	7.00E-03	9.22E-01	7.00E-03	8.43E-01
1.00E-02	9.32E-01	1.00E-02	9.21E-01	1.00E-02	8.41E-01
2.00E-02	8.79E-01	2.00E-02	8.68E-01	2.00E-02	7.05E-01
3.00E-02	8.74E-01	3.00E-02	8.21E-01	3.00E-02	6.80E-01
5.00E-02	8.28E-01	5.00E-02	7.64E-01	5.00E-02	5.21E-01
7.00E-02	7.74E-01	7.00E-02	6.68E-01	7.00E-02	4.48E-01
1.00E-01	6.92E-01	1.00E-01	6.67E-01	1.00E-01	4.06E-01
2.00E-01	5.57E-01	2.00E-01	4.88E-01	2.00E-01	1.70E-01
3.00E-01	4.79E-01	3.00E-01	4.14E-01	3.00E-01	1.31E-01
5.00E-01	3.87E-01	5.00E-01	3.19E-01	5.00E-01	9.21E-02
7.00E-01	3.07E-01	7.00E-01	2.09E-01	7.00E-01	6.37E-02
1.00E+00	1.53E-01	1.00E+00	1.46E-01	1.00E+00	3.67E-02
2.00E+00	8.90E-02	2.00E+00	6.41E-02	2.00E+00	1.18E-02
3.00E+00	7.11E-02	3.00E+00	3.60E-02	3.00E+00	1.18E-02
5.00E+00	2.20E-02	4.76E+00	1.16E-02	5.00E+00	1.04E-02
7.00E+00	9.67E-03	N.D.	N.D.	7.00E+00	4.14E-03
1.00E+01	1.20E-03	N.D.	N.D.	8.59E+00	1.20E-03
1.26E+01	1.20E-03	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

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DATE AND TIME OF RUN = MACCS2 11/24/93 13:13:35 Fixed Noble Gas Omission: Version 1.02, 5/3/93
 "ATMOS" DESCRIPTION = WSNATM.INP, RFP METEOROLOGICAL DATA, EPA METHOD, NO WAKE EFFECTS
 "EARLY" DESCRIPTION = WSNEAR.INP, WIND-SHIFT WITHOUT ROTATION, 50-MILE POPULATION
 "CHRONC" DESCRIPTION = COLOCHRN.INP, NO PROT ACTIONS, COSTS, OR DECON, 50 YR EXPOSURE.

SOURCE TERM 2 OF 2:

1 g Pu, 10 min, ground-level release, RFP met data, with fire

OVERALL RESULTS OBTAINED BY COMBINING 1 EMERGENCY RESPONSE COHORTS FROM "EARLY" WITH THE WEIGHTING FRACTIONS BELOW APPLIED TO THEM:

FRACTION OF THE PEOPLE

COHORT 1 = NO EVACUATION

1.000

AND THEN MERGING THE 1 RESULTS ABOVE WITH THE SINGLE SET OF RESULTS FROM "CHRONC" DESCRIBED BELOW:

COHORT 2 = COLOCHRN.INP, NO PROT ACTIONS, COSTS, OR DECON, 50 YR EXPOSURE.

RESULTS WHICH ARE PRODUCED ONLY BY "EARLY" OR ONLY BY "CHRONC" ARE PRESENTED IN LATER SECTIONS.

11/24/93	13:13:35	PAGE	9	PROB	MEAN	50TH	QUANTILES	90TH	95TH	99TH	99.9TH	PEAK	PEAK	PEAK
				NON-ZERO								CONS	PROB	TRIAL
HEALTH EFFECTS CASES														
CAN FAT/TOTAL	0-80.5 KM	1.0000	1.80E-02	6.40E-03	3.31E-02	7.52E-02	1.65E-01	NOT-FOUND	4.05E-01	1.20E-03	88			
CAN FAT/BONE	0-80.5 KM	1.0000	3.69E-04	1.48E-04	7.16E-04	1.54E-03	3.82E-03	NOT-FOUND	8.36E-03	1.20E-03	88			
CAN FAT/LUNG	0-80.5 KM	1.0000	1.56E-02	6.27E-03	3.03E-02	6.00E-02	1.40E-01	NOT-FOUND	3.51E-01	1.20E-03	88			
CAN FAT/LIVER	0-80.5 KM	1.0000	2.01E-03	7.52E-04	4.36E-03	8.00E-03	2.36E-02	NOT-FOUND	4.55E-02	1.20E-03	88			
AVERAGE INDIVIDUAL RISK														
CAN FAT/TOTAL	0.6-3.2 KM	1.0000	1.41E-07	1.05E-07	2.41E-07	2.73E-07	7.55E-07	NOT-FOUND	1.57E-06	2.94E-03	22			
POPULATION DOSE (SV)														
L-EDEWBODY TOT LIF	0-80.5 KM	1.0000	5.76E-01	2.12E-01	1.04E+00	2.33E+00	5.86E+00	NOT-FOUND	1.30E+01	1.20E-03	88			
L-BONE SUR TOT LIF	0-80.5 KM	1.0000	6.15E+00	2.50E+00	1.26E+01	2.49E+01	6.15E+01	NOT-FOUND	1.39E+02	1.20E-03	88			
L-LUNGS TOT LIF	0-80.5 KM	1.0000	1.95E+00	7.37E-01	4.34E+00	8.00E+00	1.68E+01	NOT-FOUND	4.39E+01	1.20E-03	88			
L-LIVER TOT LIF	0-80.5 KM	1.0000	1.34E+00	4.52E-01	2.74E+00	5.59E+00	1.39E+01	NOT-FOUND	3.04E+01	1.20E-03	88			
POPULATION WEIGHTED RISK														
CAN FAT/TOTAL	0-80.5 KM	1.0000	8.01E-09	2.74E-09	1.75E-08	3.15E-08	8.28E-08	NOT-FOUND	1.81E-07	1.20E-03	88			
CAN FAT/TOTAL	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0			
CAN FAT/BONE	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0			
CAN FAT/LUNG	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0			
CAN FAT/LIVER	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0			
PEAK DOSE FOUND ON SPATIAL GRID (SV)														
L-EDEWBODY	0-0.2 KM	1.0000	2.89E-03	2.37E-04	8.24E-03	9.93E-03	NOT-FOUND	NOT-FOUND	2.04E-02	1.99E-02	36			
L-EDEWBODY	0.2-0.6 KM	1.0000	3.90E-04	2.41E-04	1.02E-03	1.29E-03	2.32E-03	NOT-FOUND	4.64E-03	2.94E-03	22			
L-EDEWBODY	0.6-3.2 KM	1.0000	1.54E-04	9.20E-05	3.41E-04	3.82E-04	4.96E-04	NOT-FOUND	8.93E-04	2.94E-03	22			
L-EDEWBODY	3.2-4.8 KM	1.0000	9.96E-05	2.36E-05	3.05E-04	3.64E-04	5.04E-04	NOT-FOUND	5.27E-04	1.20E-03	54			
L-EDEWBODY	4.8-6.4 KM	1.0000	6.59E-05	1.96E-05	2.09E-04	2.99E-04	NOT-FOUND	NOT-FOUND	3.63E-04	1.32E-02	35			
L-EDEWBODY	6.4-8.0 KM	1.0000	4.67E-05	1.33E-05	1.48E-04	2.13E-04	NOT-FOUND	NOT-FOUND	2.65E-04	1.32E-02	65			
L-EDEWBODY	8.0-16.1 KM	1.0000	2.37E-05	6.17E-06	6.04E-05	1.08E-04	NOT-FOUND	NOT-FOUND	1.62E-04	1.32E-02	65			
L-EDEWBODY	16.1-32.2 KM	1.0000	6.29E-06	2.41E-06	1.59E-05	2.24E-05	NOT-FOUND	NOT-FOUND	4.14E-05	1.32E-02	65			
L-EDEWBODY	32.2-48.3 KM	1.0000	2.74E-06	1.42E-06	5.85E-06	9.18E-06	1.34E-05	NOT-FOUND	2.36E-05	1.20E-03	88			
L-EDEWBODY	48.3-64.4 KM	1.0000	1.63E-06	8.16E-07	3.45E-06	5.02E-06	9.85E-06	NOT-FOUND	2.78E-05	3.17E-03	77			
L-EDEWBODY	64.4-80.5 KM	1.0000	1.15E-06	5.78E-07	2.76E-06	3.95E-06	7.57E-06	NOT-FOUND	8.50E-06	3.60E-03	87			

		PROB	QUANTILES					PEAK		PEAK	PEAK
		NON-ZERO	MEAN	50TH	90TH	95TH	99TH	99.9TH	CONS	PROB	TRIAL
PEAK DOSE FOUND ON SPATIAL GRID (SV)											
L-BONE SUR	0-0.2 KM	1.0000	3.08E-02	2.37E-03	8.62E-02	1.01E-01	NOT-FOUND	NOT-FOUND	2.18E-01	1.99E-02	34
L-BONE SUR	0.2-0.6 KM	1.0000	4.16E-03	2.47E-03	1.03E-02	1.57E-02	2.65E-02	NOT-FOUND	4.98E-02	2.94E-03	22
L-BONE SUR	0.6-3.2 KM	1.0000	1.64E-03	9.20E-04	3.51E-03	3.93E-03	5.34E-03	NOT-FOUND	9.57E-03	2.94E-03	22
L-BONE SUR	3.2-4.8 KM	1.0000	1.06E-03	2.79E-04	3.09E-03	4.01E-03	5.19E-03	NOT-FOUND	5.63E-03	1.20E-03	54
L-BONE SUR	4.8-6.4 KM	1.0000	7.04E-04	2.20E-04	2.21E-03	3.10E-03	NOT-FOUND	NOT-FOUND	3.87E-03	1.32E-02	34
L-BONE SUR	6.4-8.0 KM	1.0000	4.98E-04	1.91E-04	1.48E-03	2.16E-03	NOT-FOUND	NOT-FOUND	2.83E-03	1.32E-02	64
L-BONE SUR	8.0-16.1 KM	1.0000	2.52E-04	7.12E-05	7.14E-04	1.09E-03	NOT-FOUND	NOT-FOUND	1.73E-03	1.32E-02	64
L-BONE SUR	16.1-32.2 KM	1.0000	6.72E-05	2.58E-05	1.75E-04	2.68E-04	NOT-FOUND	NOT-FOUND	4.41E-04	1.32E-02	64
L-BONE SUR	32.2-48.3 KM	1.0000	2.93E-05	1.49E-05	7.10E-05	9.61E-05	2.08E-04	NOT-FOUND	2.53E-04	1.20E-03	84
L-BONE SUR	48.3-64.4 KM	1.0000	1.74E-05	8.92E-06	3.66E-05	5.11E-05	1.34E-04	NOT-FOUND	2.98E-04	3.17E-03	74
L-BONE SUR	64.4-80.5 KM	1.0000	1.23E-05	6.43E-06	2.82E-05	4.05E-05	7.78E-05	NOT-FOUND	9.11E-05	3.60E-03	84
L-LUNGS	0-0.2 KM	1.0000	9.79E-03	8.12E-04	2.54E-02	3.02E-02	NOT-FOUND	NOT-FOUND	6.91E-02	1.99E-02	34
L-LUNGS	0.2-0.6 KM	1.0000	1.32E-03	8.26E-04	3.07E-03	4.25E-03	7.98E-03	NOT-FOUND	1.56E-02	2.94E-03	22
L-LUNGS	0.6-3.2 KM	1.0000	5.22E-04	2.76E-04	1.18E-03	1.34E-03	1.81E-03	NOT-FOUND	3.00E-03	2.94E-03	22
L-LUNGS	3.2-4.8 KM	1.0000	3.38E-04	8.10E-05	1.01E-03	1.11E-03	1.36E-03	NOT-FOUND	1.79E-03	1.20E-03	54
L-LUNGS	4.8-6.4 KM	1.0000	2.24E-04	6.51E-05	7.37E-04	1.03E-03	NOT-FOUND	NOT-FOUND	1.23E-03	1.32E-02	34
L-LUNGS	6.4-8.0 KM	1.0000	1.58E-04	4.83E-05	5.02E-04	7.40E-04	NOT-FOUND	NOT-FOUND	8.99E-04	1.32E-02	64
L-LUNGS	8.0-16.1 KM	1.0000	8.02E-05	2.31E-05	2.19E-04	3.43E-04	NOT-FOUND	NOT-FOUND	5.51E-04	1.32E-02	64
L-LUNGS	16.1-32.2 KM	1.0000	2.13E-05	8.25E-06	4.99E-05	8.42E-05	NOT-FOUND	NOT-FOUND	1.40E-04	1.32E-02	64
L-LUNGS	32.2-48.3 KM	1.0000	9.30E-06	5.15E-06	2.18E-05	3.58E-05	5.64E-05	NOT-FOUND	7.97E-05	1.20E-03	84
L-LUNGS	48.3-64.4 KM	1.0000	5.53E-06	2.66E-06	1.15E-05	1.68E-05	3.71E-05	NOT-FOUND	9.37E-05	3.17E-03	74
L-LUNGS	64.4-80.5 KM	1.0000	3.89E-06	1.86E-06	9.28E-06	1.34E-05	2.35E-05	NOT-FOUND	2.86E-05	3.60E-03	84
L-LIVER	0-0.2 KM	1.0000	6.72E-03	5.75E-04	1.52E-02	2.09E-02	NOT-FOUND	NOT-FOUND	4.74E-02	1.99E-02	34
L-LIVER	0.2-0.6 KM	1.0000	9.07E-04	4.97E-04	2.15E-03	3.37E-03	5.19E-03	NOT-FOUND	1.08E-02	2.94E-03	22
L-LIVER	0.6-3.2 KM	1.0000	3.58E-04	1.77E-04	7.70E-04	8.37E-04	1.07E-03	NOT-FOUND	2.08E-03	2.94E-03	22
L-LIVER	3.2-4.8 KM	1.0000	2.31E-04	5.67E-05	7.24E-04	1.00E-03	1.09E-03	NOT-FOUND	1.23E-03	1.20E-03	54
L-LIVER	4.8-6.4 KM	1.0000	1.53E-04	4.48E-05	5.18E-04	6.98E-04	NOT-FOUND	NOT-FOUND	8.43E-04	1.32E-02	34
L-LIVER	6.4-8.0 KM	1.0000	1.08E-04	3.70E-05	3.40E-04	5.14E-04	NOT-FOUND	NOT-FOUND	6.16E-04	1.32E-02	64
L-LIVER	8.0-16.1 KM	1.0000	5.50E-05	1.65E-05	1.42E-04	3.10E-04	NOT-FOUND	NOT-FOUND	3.77E-04	1.32E-02	64
L-LIVER	16.1-32.2 KM	1.0000	1.46E-05	5.64E-06	3.52E-05	5.48E-05	NOT-FOUND	NOT-FOUND	9.61E-05	1.32E-02	64
L-LIVER	32.2-48.3 KM	1.0000	6.38E-06	3.25E-06	1.48E-05	2.39E-05	3.65E-05	NOT-FOUND	5.51E-05	1.20E-03	84
L-LIVER	48.3-64.4 KM	1.0000	3.79E-06	1.78E-06	8.13E-06	1.23E-05	2.37E-05	NOT-FOUND	6.50E-05	3.17E-03	74
L-LIVER	64.4-80.5 KM	1.0000	2.67E-06	1.39E-06	6.51E-06	9.15E-06	1.49E-05	NOT-FOUND	1.98E-05	3.60E-03	84

DATE AND TIME OF RUN = MACCS2 11/24/93 13:13:35 Fixed Noble Gas Omission: Version 1.02, 5/3/93
 "ATMOS" DESCRIPTION = WSNATM.INP, RFP METEOROLOGICAL DATA, EPA METHOD, NO WAKE EFFECTS
 "EARLY" DESCRIPTION = WSNEAR.INP, WIND-SHIFT WITHOUT ROTATION, 50-MILE POPULATION

SOURCE TERM 2 OF 2:

1 g Pu, 10 min, ground-level release, RFP met data, with fire

RESULTS FOR A SINGLE EMERGENCY RESPONSE COHORT WITHOUT ANY WEIGHTING FRACTIONS BEING APPLIED

COHORT 1 = NO EVACUATION

11/24/93	13:13:35	PAGE 11	PROB NON-ZERO	MEAN	50TH	QUANTILES				99TH	99.9TH	PEAK CONS	PEAK PROB	PEAK TRIAL
HEALTH EFFECTS CASES														
CAN FAT/TOTAL	0-80.5 KM	1.0000	1.20E-02	4.96E-03	2.77E-02	4.33E-02	NOT-FOUND	NOT-FOUND	1.45E-01	1.16E-02	25			
CAN FAT/BONE	0-80.5 KM	1.0000	2.46E-04	9.95E-05	4.72E-04	8.83E-04	NOT-FOUND	NOT-FOUND	2.96E-03	1.16E-02	25			
CAN FAT/LUNG	0-80.5 KM	1.0000	1.04E-02	4.27E-03	2.49E-02	4.05E-02	NOT-FOUND	NOT-FOUND	1.26E-01	1.16E-02	25			
CAN FAT/LIVER	0-80.5 KM	1.0000	1.34E-03	5.86E-04	2.80E-03	4.64E-03	NOT-FOUND	NOT-FOUND	1.61E-02	1.16E-02	25			
EARLY FATALITY DISTANCE (KM)														
ERL FAT/TOTAL RISK > 0.000		0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0			
POPULATION EXCEEDING DOSE														
EARLY dose to L-EDEWBODY > 0.050 SV		0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0			
AVERAGE INDIVIDUAL RISK														
CAN FAT/TOTAL	0.6-3.2 KM	1.0000	9.86E-08	8.60E-08	1.74E-07	2.05E-07	2.30E-07	NOT-FOUND	2.40E-07	5.37E-03	55			
ERL FAT/TOTAL	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0			
POPULATION DOSE (SV)														
L-EDEWBODY TOT LIF	0-80.5 KM	1.0000	3.84E-01	1.61E-01	8.48E-01	1.31E+00	NOT-FOUND	NOT-FOUND	4.63E+00	1.16E-02	25			
L-BONE SUR TOT LIF	0-80.5 KM	1.0000	4.10E+00	1.61E+00	9.33E+00	1.58E+01	NOT-FOUND	NOT-FOUND	4.94E+01	1.16E-02	25			
L-LUNGS TOT LIF	0-80.5 KM	1.0000	1.30E+00	5.83E-01	2.80E+00	4.64E+00	NOT-FOUND	NOT-FOUND	1.57E+01	1.16E-02	25			
L-LIVER TOT LIF	0-80.5 KM	1.0000	8.92E-01	3.96E-01	1.85E+00	2.87E+00	NOT-FOUND	NOT-FOUND	1.08E+01	1.16E-02	25			
POPULATION WEIGHTED RISK														
CAN FAT/TOTAL	0-80.5 KM	1.0000	5.36E-09	2.41E-09	1.22E-08	1.88E-08	NOT-FOUND	NOT-FOUND	6.46E-08	1.16E-02	25			
CAN FAT/TOTAL	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0			
CAN FAT/BONE	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0			
CAN FAT/LUNG	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0			
CAN FAT/LIVER	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0			
PEAK DOSE FOUND ON SPATIAL GRID (SV)														
L-EDEWBODY	0-0.2 KM	1.0000	2.34E-03	1.63E-04	5.91E-03	6.71E-03	NOT-FOUND	NOT-FOUND	1.79E-02	1.99E-02	36			
L-EDEWBODY	0.2-0.6 KM	1.0000	2.99E-04	1.62E-04	6.80E-04	1.22E-03	NOT-FOUND	NOT-FOUND	1.72E-03	1.99E-02	36			
L-EDEWBODY	0.6-3.2 KM	1.0000	1.33E-04	6.43E-05	3.09E-04	3.22E-04	3.57E-04	NOT-FOUND	3.71E-04	5.37E-03	55			
L-EDEWBODY	3.2-4.8 KM	1.0000	8.89E-05	1.78E-05	3.00E-04	3.25E-04	3.91E-04	NOT-FOUND	4.99E-04	1.20E-03	54			
L-EDEWBODY	4.8-6.4 KM	1.0000	5.89E-05	1.77E-05	2.01E-04	2.68E-04	NOT-FOUND	NOT-FOUND	3.44E-04	1.32E-02	35			
L-EDEWBODY	6.4-8.0 KM	1.0000	4.17E-05	1.11E-05	1.25E-04	2.06E-04	NOT-FOUND	NOT-FOUND	2.51E-04	1.32E-02	65			
L-EDEWBODY	8.0-16.1 KM	1.0000	2.13E-05	5.39E-06	5.78E-05	1.06E-04	NOT-FOUND	NOT-FOUND	1.54E-04	1.32E-02	65			
L-EDEWBODY	16.1-32.2 KM	1.0000	5.40E-06	2.17E-06	1.45E-05	1.99E-05	NOT-FOUND	NOT-FOUND	3.91E-05	1.32E-02	65			
L-EDEWBODY	32.2-48.3 KM	1.0000	2.28E-06	1.08E-06	5.29E-06	6.56E-06	NOT-FOUND	NOT-FOUND	1.88E-05	1.30E-02	72			
L-EDEWBODY	48.3-64.4 KM	1.0000	1.31E-06	7.32E-07	2.76E-06	3.64E-06	NOT-FOUND	NOT-FOUND	9.01E-06	1.32E-02	65			
L-EDEWBODY	64.4-80.5 KM	1.0000	9.22E-07	4.60E-07	2.17E-06	2.80E-06	NOT-FOUND	NOT-FOUND	6.93E-06	1.32E-02	65			
L-BONE SUR	0-0.2 KM	1.0000	2.50E-02	1.63E-03	5.92E-02	6.72E-02	NOT-FOUND	NOT-FOUND	1.91E-01	1.99E-02	36			
L-BONE SUR	0.2-0.6 KM	1.0000	3.19E-03	1.62E-03	6.92E-03	1.25E-02	NOT-FOUND	NOT-FOUND	1.83E-02	1.99E-02	36			

PEAK DOSE FOUND ON SPATIAL GRID (SV)		PROB	QUANTILES					PEAK CONS	PEAK PROB	PEAK TRIAL
		NON-ZERO	MEAN	50TH	90TH	95TH	99TH	99.9TH		
L-BONE SUR	0.6-3.2 KM	1.0000	1.42E-03	7.53E-04	3.17E-03	3.34E-03	3.78E-03	NOT-FOUND	3.96E-03	5.37E-03
L-BONE SUR	3.2-4.8 KM	1.0000	9.48E-04	2.20E-04	3.01E-03	3.61E-03	5.05E-03	NOT-FOUND	5.32E-03	1.20E-03
L-BONE SUR	4.8-6.4 KM	1.0000	6.29E-04	1.86E-04	2.01E-03	3.08E-03	NOT-FOUND	NOT-FOUND	3.67E-03	1.32E-02
L-BONE SUR	6.4-8.0 KM	1.0000	4.45E-04	1.14E-04	1.45E-03	2.13E-03	NOT-FOUND	NOT-FOUND	2.68E-03	1.32E-02
L-BONE SUR	8.0-16.1 KM	1.0000	2.27E-04	5.46E-05	5.95E-04	1.07E-03	NOT-FOUND	NOT-FOUND	1.64E-03	1.32E-02
L-BONE SUR	16.1-32.2 KM	1.0000	5.76E-05	2.27E-05	1.49E-04	2.02E-04	NOT-FOUND	NOT-FOUND	4.17E-04	1.32E-02
L-BONE SUR	32.2-48.3 KM	1.0000	2.43E-05	1.21E-05	5.33E-05	6.66E-05	NOT-FOUND	NOT-FOUND	2.00E-04	1.30E-02
L-BONE SUR	48.3-64.4 KM	1.0000	1.39E-05	7.35E-06	3.08E-05	4.23E-05	NOT-FOUND	NOT-FOUND	9.61E-05	1.32E-02
L-BONE SUR	64.4-80.5 KM	1.0000	9.83E-06	4.85E-06	2.24E-05	3.09E-05	NOT-FOUND	NOT-FOUND	7.39E-05	1.32E-02
L-LUNGS	0-0.2 KM	1.0000	7.95E-03	5.81E-04	2.33E-02	2.82E-02	NOT-FOUND	NOT-FOUND	6.07E-02	1.99E-02
L-LUNGS	0.2-0.6 KM	1.0000	1.02E-03	5.01E-04	2.79E-03	3.62E-03	NOT-FOUND	NOT-FOUND	5.83E-03	1.99E-02
L-LUNGS	0.6-3.2 KM	1.0000	4.51E-04	2.61E-04	1.04E-03	1.09E-03	1.21E-03	NOT-FOUND	1.26E-03	5.37E-03
L-LUNGS	3.2-4.8 KM	1.0000	3.02E-04	6.60E-05	1.00E-03	1.09E-03	1.32E-03	NOT-FOUND	1.69E-03	1.20E-03
L-LUNGS	4.8-6.4 KM	1.0000	2.00E-04	5.55E-05	6.29E-04	8.90E-04	NOT-FOUND	NOT-FOUND	1.17E-03	1.32E-02
L-LUNGS	6.4-8.0 KM	1.0000	1.42E-04	3.65E-05	4.35E-04	7.19E-04	NOT-FOUND	NOT-FOUND	8.54E-04	1.32E-02
L-LUNGS	8.0-16.1 KM	1.0000	7.22E-05	1.78E-05	2.03E-04	3.21E-04	NOT-FOUND	NOT-FOUND	5.24E-04	1.32E-02
L-LUNGS	16.1-32.2 KM	1.0000	1.83E-05	7.49E-06	4.54E-05	6.94E-05	NOT-FOUND	NOT-FOUND	1.33E-04	1.32E-02
L-LUNGS	32.2-48.3 KM	1.0000	7.75E-06	3.93E-06	1.74E-05	2.38E-05	NOT-FOUND	NOT-FOUND	6.37E-05	1.30E-02
L-LUNGS	48.3-64.4 KM	1.0000	4.44E-06	2.51E-06	1.02E-05	1.35E-05	NOT-FOUND	NOT-FOUND	3.06E-05	1.32E-02
L-LUNGS	64.4-80.5 KM	1.0000	3.13E-06	1.75E-06	7.38E-06	9.37E-06	NOT-FOUND	NOT-FOUND	2.35E-05	1.32E-02
L-LIVER	0-0.2 KM	1.0000	5.43E-03	3.86E-04	1.42E-02	1.84E-02	NOT-FOUND	NOT-FOUND	4.15E-02	1.99E-02
L-LIVER	0.2-0.6 KM	1.0000	6.94E-04	3.48E-04	1.82E-03	2.32E-03	NOT-FOUND	NOT-FOUND	3.99E-03	1.99E-02
L-LIVER	0.6-3.2 KM	1.0000	3.08E-04	1.68E-04	7.28E-04	7.73E-04	NOT-FOUND	NOT-FOUND	8.63E-04	1.44E-02
L-LIVER	3.2-4.8 KM	1.0000	2.07E-04	4.57E-05	7.01E-04	8.49E-04	1.05E-03	NOT-FOUND	1.16E-03	1.20E-03
L-LIVER	4.8-6.4 KM	1.0000	1.37E-04	3.21E-05	4.48E-04	6.27E-04	NOT-FOUND	NOT-FOUND	7.99E-04	1.32E-02
L-LIVER	6.4-8.0 KM	1.0000	9.69E-05	2.34E-05	2.80E-04	5.10E-04	NOT-FOUND	NOT-FOUND	5.84E-04	1.32E-02
L-LIVER	8.0-16.1 KM	1.0000	4.94E-05	1.13E-05	1.29E-04	3.07E-04	NOT-FOUND	NOT-FOUND	3.58E-04	1.32E-02
L-LIVER	16.1-32.2 KM	1.0000	1.25E-05	4.84E-06	3.15E-05	4.96E-05	NOT-FOUND	NOT-FOUND	9.09E-05	1.32E-02
L-LIVER	32.2-48.3 KM	1.0000	5.30E-06	2.90E-06	1.10E-05	1.50E-05	NOT-FOUND	NOT-FOUND	4.36E-05	1.30E-02
L-LIVER	48.3-64.4 KM	1.0000	3.04E-06	1.67E-06	6.53E-06	8.62E-06	NOT-FOUND	NOT-FOUND	2.09E-05	1.32E-02
L-LIVER	64.4-80.5 KM	1.0000	2.14E-06	1.25E-06	5.26E-06	6.58E-06	NOT-FOUND	NOT-FOUND	1.61E-05	1.32E-02

DATE AND TIME OF RUN = MACCS2 11/24/93 13:13:35 Fixed Noble Gas Omission: Version 1.02, 5/3/93
 "ATMOS" DESCRIPTION = WSNATM.INP, RFP METEOROLOGICAL DATA, EPA METHOD, NO WAKE EFFECTS
 "EARLY" DESCRIPTION = WSNEAR.INP, WIND-SHIFT WITHOUT ROTATION, 50-MILE POPULATION
 "CHRONC" DESCRIPTION = COLOCHRN.INP, NO PROT ACTIONS, COSTS, OR DECON, 50 YR EXPOSURE.

SOURCE TERM 2 OF 2:

1 g Pu, 10 min, ground-level release, RFP met data, with fire

RESULTS FROM THE "CHRONC" MODULE ALONE

COHORT 2 = COLOCHRN.INP, NO PROT ACTIONS, COSTS, OR DECON, 50 YR EXPOSURE.

11/24/93	13:13:35	PAGE 13	PROB	MEAN	50TH	QUANTILES	90TH	95TH	99TH	99.9TH	PEAK	PEAK	PEAK
			NON-ZERO								CONS	PROB	TRIAL
HEALTH EFFECTS CASES													
CAN FAT/TOTAL	0-80.5 KM	1.0000	5.94E-03	1.53E-03	8.32E-03	1.68E-02	1.11E-01	NOT-FOUND	2.78E-01	1.20E-03	88		
CAN FAT/BONE	0-80.5 KM	1.0000	1.23E-04	2.90E-05	2.15E-04	4.15E-04	3.07E-03	NOT-FOUND	5.78E-03	1.20E-03	88		
CAN FAT/LUNG	0-80.5 KM	1.0000	5.15E-03	1.37E-03	7.61E-03	1.61E-02	1.03E-01	NOT-FOUND	2.41E-01	1.20E-03	88		
CAN FAT/LIVER	0-80.5 KM	1.0000	6.72E-04	1.75E-04	1.08E-03	2.23E-03	1.19E-02	NOT-FOUND	3.15E-02	1.20E-03	88		
AVERAGE INDIVIDUAL RISK													
CAN FAT/TOTAL	0.6-3.2 KM	0.9999	4.20E-08	2.19E-08	4.95E-08	6.18E-08	7.29E-07	NOT-FOUND	1.43E-06	2.94E-03	22		
POPULATION DOSE (SV)													
L-EDEWBODY TOT LIF	0-80.5 KM	1.0000	1.92E-01	4.83E-02	3.18E-01	5.71E-01	3.49E+00	NOT-FOUND	8.97E+00	1.20E-03	88		
L-BONE SUR TOT LIF	0-80.5 KM	1.0000	2.06E+00	4.83E-01	3.28E+00	6.30E+00	5.07E+01	NOT-FOUND	9.63E+01	1.20E-03	88		
L-LUNGS TOT LIF	0-80.5 KM	1.0000	6.43E-01	1.61E-01	1.08E+00	2.23E+00	1.19E+01	NOT-FOUND	3.02E+01	1.20E-03	88		
L-LIVER TOT LIF	0-80.5 KM	1.0000	4.48E-01	9.89E-02	7.48E-01	1.42E+00	1.01E+01	NOT-FOUND	2.10E+01	1.20E-03	88		
POPULATION WEIGHTED RISK													
CAN FAT/TOTAL	0-80.5 KM	1.0000	2.65E-09	6.78E-10	3.79E-09	8.06E-09	5.16E-08	NOT-FOUND	1.24E-07	1.20E-03	88		
CAN FAT/TOTAL	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0		
CAN FAT/BONE	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0		
CAN FAT/LUNG	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0		
CAN FAT/LIVER	0.6-3.2 KM	0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0		
PEAK DOSE FOUND ON SPATIAL GRID (SV)													
L-EDEWBODY	0-0.2 KM	0.9862	5.48E-04	3.12E-05	1.44E-03	1.94E-03	5.87E-03	NOT-FOUND	1.56E-02	2.94E-03	22		
L-EDEWBODY	0.2-0.6 KM	0.9999	9.10E-05	3.07E-05	1.27E-04	2.12E-04	1.33E-03	NOT-FOUND	3.94E-03	2.94E-03	22		
L-EDEWBODY	0.6-3.2 KM	0.9999	2.12E-05	1.05E-05	2.49E-05	2.86E-05	3.18E-04	NOT-FOUND	7.38E-04	2.94E-03	22		
L-EDEWBODY	3.2-4.8 KM	0.9999	1.06E-05	2.79E-06	2.17E-05	2.67E-05	1.23E-04	NOT-FOUND	3.03E-04	2.94E-03	22		
L-EDEWBODY	4.8-6.4 KM	0.9999	6.98E-06	1.97E-06	1.32E-05	1.75E-05	8.82E-05	NOT-FOUND	1.92E-04	2.94E-03	22		
L-EDEWBODY	6.4-8.0 KM	0.9999	4.93E-06	1.56E-06	1.13E-05	1.69E-05	6.49E-05	NOT-FOUND	1.28E-04	2.94E-03	83		
L-EDEWBODY	8.0-16.1 KM	1.0000	2.39E-06	6.34E-07	5.34E-06	7.79E-06	3.09E-05	6.47E-05	1.08E-04	7.42E-04	15		
L-EDEWBODY	16.1-32.2 KM	1.0000	8.91E-07	2.24E-07	1.38E-06	3.31E-06	1.29E-05	2.91E-05	3.03E-05	8.85E-04	17		
L-EDEWBODY	32.2-48.3 KM	1.0000	4.62E-07	1.14E-07	4.81E-07	1.86E-06	8.05E-06	NOT-FOUND	1.61E-05	1.34E-03	31		
L-EDEWBODY	48.3-64.4 KM	1.0000	3.24E-07	7.89E-08	2.60E-07	8.10E-07	6.53E-06	NOT-FOUND	2.20E-05	3.17E-03	77		
L-EDEWBODY	64.4-80.5 KM	1.0000	2.26E-07	5.30E-08	1.73E-07	8.58E-07	4.24E-06	NOT-FOUND	6.18E-06	3.60E-03	87		
L-BONE SUR	0-0.2 KM	0.9862	5.89E-03	3.14E-04	1.44E-02	1.94E-02	5.87E-02	NOT-FOUND	1.67E-01	2.94E-03	22		
L-BONE SUR	0.2-0.6 KM	0.9999	9.77E-04	3.15E-04	1.54E-03	2.12E-03	1.61E-02	NOT-FOUND	4.23E-02	2.94E-03	22		
L-BONE SUR	0.6-3.2 KM	0.9999	2.27E-04	1.30E-04	2.76E-04	3.82E-04	3.18E-03	NOT-FOUND	7.93E-03	2.94E-03	22		
L-BONE SUR	3.2-4.8 KM	0.9999	1.14E-04	2.79E-05	2.23E-04	2.71E-04	1.33E-03	NOT-FOUND	3.25E-03	2.94E-03	22		
L-BONE SUR	4.8-6.4 KM	0.9999	7.50E-05	1.97E-05	1.40E-04	1.99E-04	9.13E-04	NOT-FOUND	2.06E-03	2.94E-03	22		
L-BONE SUR	6.4-8.0 KM	0.9999	5.29E-05	1.72E-05	1.20E-04	1.72E-04	6.85E-04	NOT-FOUND	1.38E-03	2.94E-03	83		
L-BONE SUR	8.0-16.1 KM	1.0000	2.56E-05	6.63E-06	6.58E-05	8.67E-05	3.11E-04	6.56E-04	1.16E-03	7.42E-04	15		

11/24/93	13:13:35	PAGE 14	PROB		QUANTILES					PEAK	PEAK	PEAK	
			NON-ZERO	MEAN	50TH	90TH	95TH	99TH	99.9TH	CONS	PROB	TRIAL	
PEAK DOSE FOUND ON SPATIAL GRID (SV)													
L-BONE SUR	16.1-32.2 KM	1.0000	9.57E-06	2.30E-06	1.38E-05	3.56E-05	1.43E-04	2.92E-04	3.26E-04	8.85E-04	1.7E-03	17	
L-BONE SUR	32.2-48.3 KM	1.0000	4.96E-06	1.25E-06	4.89E-06	1.97E-05	9.04E-05	NOT-FOUND	1.73E-04	1.34E-03	3.1E-03	31	
L-BONE SUR	48.3-64.4 KM	1.0000	3.47E-06	8.85E-07	3.32E-06	8.53E-06	6.73E-05	NOT-FOUND	2.37E-04	3.17E-03	7.7E-03	77	
L-BONE SUR	64.4-80.5 KM	1.0000	2.43E-06	5.58E-07	2.28E-06	9.24E-06	4.84E-05	NOT-FOUND	6.63E-05	3.60E-03	8.7E-03	87	
L-LUNGS	0-0.2 KM	0.9862	1.84E-03	1.05E-04	4.30E-03	6.58E-03	2.09E-02	NOT-FOUND	5.23E-02	2.94E-03	2.2E-03	22	
L-LUNGS	0.2-0.6 KM	0.9999	3.06E-04	1.02E-04	4.45E-04	7.38E-04	5.19E-03	NOT-FOUND	1.32E-02	2.94E-03	2.2E-03	22	
L-LUNGS	0.6-3.2 KM	0.9999	7.11E-05	4.05E-05	8.20E-05	9.49E-05	1.08E-03	NOT-FOUND	2.48E-03	2.94E-03	2.2E-03	22	
L-LUNGS	3.2-4.8 KM	0.9999	3.57E-05	9.37E-06	7.43E-05	8.98E-05	5.19E-04	NOT-FOUND	1.02E-03	2.94E-03	2.2E-03	22	
L-LUNGS	4.8-6.4 KM	0.9999	2.35E-05	6.88E-06	4.96E-05	6.30E-05	2.76E-04	NOT-FOUND	6.44E-04	2.94E-03	2.2E-03	22	
L-LUNGS	6.4-8.0 KM	0.9999	1.66E-05	4.94E-06	3.44E-05	4.47E-05	2.18E-04	NOT-FOUND	4.31E-04	2.94E-03	8.3E-03	83	
L-LUNGS	8.0-16.1 KM	1.0000	8.03E-06	2.09E-06	1.94E-05	2.55E-05	1.02E-04	1.85E-04	3.63E-04	7.42E-04	1.5E-03	15	
L-LUNGS	16.1-32.2 KM	1.0000	3.00E-06	7.74E-07	4.76E-06	1.03E-05	4.57E-05	9.72E-05	1.02E-04	8.85E-04	1.7E-03	17	
L-LUNGS	32.2-48.3 KM	1.0000	1.55E-06	4.10E-07	1.66E-06	6.40E-06	2.73E-05	NOT-FOUND	5.41E-05	1.34E-03	3.1E-03	31	
L-LUNGS	48.3-64.4 KM	1.0000	1.09E-06	2.91E-07	9.53E-07	2.50E-06	1.93E-05	NOT-FOUND	7.41E-05	3.17E-03	7.7E-03	77	
L-LUNGS	64.4-80.5 KM	1.0000	7.59E-07	1.86E-07	6.20E-07	2.93E-06	1.36E-05	NOT-FOUND	2.08E-05	3.60E-03	8.7E-03	87	
L-LIVER	0-0.2 KM	0.9862	1.28E-03	7.19E-05	2.71E-03	4.60E-03	1.23E-02	NOT-FOUND	3.64E-02	2.94E-03	2.2E-03	22	
L-LIVER	0.2-0.6 KM	0.9999	2.13E-04	7.26E-05	3.31E-04	5.26E-04	3.50E-03	NOT-FOUND	9.21E-03	2.94E-03	2.2E-03	22	
L-LIVER	0.6-3.2 KM	0.9999	4.95E-05	2.60E-05	5.71E-05	6.64E-05	7.29E-04	NOT-FOUND	1.73E-03	2.94E-03	2.2E-03	22	
L-LIVER	3.2-4.8 KM	0.9999	2.48E-05	6.54E-06	5.17E-05	6.27E-05	3.18E-04	NOT-FOUND	7.09E-04	2.94E-03	2.2E-03	22	
L-LIVER	4.8-6.4 KM	0.9999	1.63E-05	4.40E-06	3.43E-05	4.44E-05	2.09E-04	NOT-FOUND	4.48E-04	2.94E-03	2.2E-03	22	
L-LIVER	6.4-8.0 KM	0.9999	1.15E-05	2.98E-06	2.30E-05	3.04E-05	1.45E-04	NOT-FOUND	3.00E-04	2.94E-03	8.3E-03	83	
L-LIVER	8.0-16.1 KM	1.0000	5.59E-06	1.64E-06	1.08E-05	1.58E-05	7.38E-05	1.82E-04	2.52E-04	7.42E-04	1.5E-03	15	
L-LIVER	16.1-32.2 KM	1.0000	2.08E-06	5.30E-07	3.34E-06	1.02E-05	3.10E-05	6.82E-05	7.10E-05	8.85E-04	1.7E-03	17	
L-LIVER	32.2-48.3 KM	1.0000	1.08E-06	2.77E-07	1.45E-06	4.66E-06	1.82E-05	NOT-FOUND	3.76E-05	1.34E-03	3.1E-03	31	
L-LIVER	48.3-64.4 KM	1.0000	7.57E-07	1.93E-07	6.21E-07	1.81E-06	1.47E-05	NOT-FOUND	5.15E-05	3.17E-03	7.7E-03	77	
L-LIVER	64.4-80.5 KM	1.0000	5.28E-07	1.12E-07	4.30E-07	1.92E-06	9.76E-06	NOT-FOUND	1.44E-05	3.60E-03	8.7E-03	87	
L-EDEWBODY POP. DOSE (SV) 0-80.5 KM													
TOTAL LONG-TERM PATHWAYS DOSE			1.0000	1.92E-01	4.83E-02	3.18E-01	5.71E-01	3.49E+00	NOT-FOUND	8.97E+00	1.20E-03	8.4E-03	84
LONG-TERM DIRECT EXPOSURE PATHWAYS			1.0000	1.91E-01	4.83E-02	3.18E-01	5.71E-01	3.49E+00	NOT-FOUND	8.97E+00	1.20E-03	8.4E-03	84
TOTAL INGESTION PATHWAYS DOSE			1.0000	1.27E-04	3.05E-05	3.19E-04	6.52E-04	NOT-FOUND	NOT-FOUND	1.62E-03	1.16E-02	4.0E-02	40
LONG-TERM GROUNDWATER DOSE			1.0000	3.33E-05	8.13E-06	5.33E-05	1.09E-04	7.19E-04	NOT-FOUND	1.56E-03	1.20E-03	8.4E-03	84
LONG-TERM RESUSPENSION DOSE			1.0000	1.91E-01	4.83E-02	3.18E-01	5.71E-01	3.49E+00	NOT-FOUND	8.97E+00	1.20E-03	8.4E-03	84
POP. DEPENDENT DECONTAMINATION DOSE			0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
AREA DEPENDENT DECONTAMINATION DOSE			0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0
GROWING SEASON MILK DOSE			1.0000	2.86E-08	1.23E-09	5.08E-08	1.47E-07	NOT-FOUND	NOT-FOUND	5.97E-07	1.16E-02	4.0E-02	40
GROWING SEASON CROP DOSE			1.0000	4.86E-05	2.15E-06	8.20E-05	1.76E-04	NOT-FOUND	NOT-FOUND	1.04E-03	1.16E-02	4.0E-02	40
LONG-TERM MILK DOSE			1.0000	7.33E-09	3.34E-09	1.53E-08	2.48E-08	7.83E-08	NOT-FOUND	1.89E-07	2.94E-03	2.2E-03	22
LONG-TERM CROP DOSE			1.0000	3.09E-05	5.57E-06	7.02E-05	1.49E-04	NOT-FOUND	NOT-FOUND	5.29E-04	1.16E-02	4.0E-02	40
WATER INGESTION DOSE			1.0000	4.71E-05	1.52E-05	7.87E-05	2.53E-04	4.60E-04	NOT-FOUND	6.21E-04	3.17E-03	7.7E-03	77
INDIVIDUAL FOOD DOSE (SV)													
IRAD = 3 IDIR = 6 : 1 y EXP			0.1832	5.80E-10	0.00E+00	1.55E-10	5.28E-09	1.12E-08	1.51E-08	1.99E-08	1.14E-04	2.0E-04	20
IRAD = 3 IDIR = 6 : 2 y EXP			0.1832	6.64E-10	0.00E+00	1.55E-10	5.45E-09	1.12E-08	1.51E-08	2.13E-08	1.14E-04	2.0E-04	20
IRAD = 3 IDIR = 6 : 5 y EXP			0.1832	7.50E-10	0.00E+00	1.55E-10	5.96E-09	1.12E-08	1.51E-08	2.20E-08	1.14E-04	2.0E-04	20
IRAD = 3 IDIR = 6 50 y EXP			0.1832	8.04E-10	0.00E+00	2.59E-10	7.21E-09	1.12E-08	1.51E-08	2.25E-08	1.14E-04	2.0E-04	20
POPULATION EXCEEDING FOOD INGESTION DOSE													
0.00E+00(SV) FOR YEAR 1			1.0000	2.36E+05	1.34E+05	7.48E+05	8.84E+05	1.11E+06	1.39E+06	1.43E+06	7.42E-04		
0.00E+00(SV) FOR YEAR 8			1.0000	2.36E+05	1.34E+05	7.48E+05	8.84E+05	1.11E+06	1.39E+06	1.43E+06	7.42E-04		
1.00E+00(SV) FOR YEAR 1			0.0000	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00		

SOURCE TERM 2 OF 2:

1 g Pu, 10 min, ground-level release, RFP met data, with fire

RESULT NAME = HEALTH EFFECTS CASES
CAN FAT/TOTAL

0-80.5 KM

PEOPLE FRACTION = 1.0000

OVERALL		EMER. RESP. # 1		CHRONC RESULTS	
X	PROB>=X	X	PROB>=X	X	PROB>=X
1.00E-07	1.00E+00	1.00E-08	1.00E+00	1.00E-07	1.00E+00
2.00E-07	1.00E+00	2.00E-08	1.00E+00	2.00E-07	1.00E+00
3.00E-07	1.00E+00	3.00E-08	1.00E+00	3.00E-07	1.00E+00
5.00E-07	1.00E+00	5.00E-08	1.00E+00	5.00E-07	1.00E+00
7.00E-07	1.00E+00	7.00E-08	1.00E+00	7.00E-07	1.00E+00
1.00E-06	1.00E+00	1.00E-07	1.00E+00	1.00E-06	1.00E+00
2.00E-06	1.00E+00	2.00E-07	1.00E+00	2.00E-06	1.00E+00
3.00E-06	1.00E+00	3.00E-07	1.00E+00	3.00E-06	1.00E+00
5.00E-06	1.00E+00	5.00E-07	1.00E+00	5.00E-06	1.00E+00
7.00E-06	1.00E+00	7.00E-07	1.00E+00	7.00E-06	1.00E+00
1.00E-05	1.00E+00	1.00E-06	1.00E+00	1.00E-05	1.00E+00
2.00E-05	1.00E+00	2.00E-06	1.00E+00	2.00E-05	9.84E-01
3.00E-05	1.00E+00	3.00E-06	1.00E+00	3.00E-05	9.75E-01
5.00E-05	1.00E+00	5.00E-06	1.00E+00	5.00E-05	9.31E-01
7.00E-05	1.00E+00	7.00E-06	1.00E+00	7.00E-05	9.24E-01
1.00E-04	9.84E-01	1.00E-05	1.00E+00	1.00E-04	9.24E-01
2.00E-04	9.31E-01	2.00E-05	1.00E+00	2.00E-04	8.41E-01
3.00E-04	9.20E-01	3.00E-05	1.00E+00	3.00E-04	8.22E-01
5.00E-04	9.11E-01	5.00E-05	1.00E+00	5.00E-04	7.06E-01
7.00E-04	8.65E-01	7.00E-05	9.83E-01	7.00E-04	6.57E-01
1.00E-03	8.62E-01	1.00E-04	9.77E-01	1.00E-03	6.08E-01
2.00E-03	7.33E-01	2.00E-04	9.10E-01	2.00E-03	4.43E-01
3.00E-03	6.54E-01	3.00E-04	9.01E-01	3.00E-03	3.47E-01
5.00E-03	5.91E-01	5.00E-04	8.55E-01	5.00E-03	2.00E-01
7.00E-03	4.70E-01	7.00E-04	8.44E-01	7.00E-03	1.22E-01
1.00E-02	4.23E-01	1.00E-03	8.05E-01	1.00E-02	8.11E-02
2.00E-02	2.33E-01	2.00E-03	6.88E-01	2.00E-02	4.24E-02
3.00E-02	1.04E-01	3.00E-03	6.21E-01	3.00E-02	3.43E-02
5.00E-02	8.43E-02	5.00E-03	4.98E-01	5.00E-02	1.62E-02
7.00E-02	5.42E-02	7.00E-03	4.28E-01	7.00E-02	1.18E-02
1.00E-01	3.63E-02	1.00E-02	3.91E-01	1.00E-01	1.18E-02
2.00E-01	6.08E-03	2.00E-02	1.63E-01	2.00E-01	4.14E-03
3.00E-01	1.20E-03	3.00E-02	8.88E-02	2.78E-01	1.20E-03
4.05E-01	1.20E-03	5.00E-02	4.00E-02	N.D.	N.D.
N.D.	N.D.	7.00E-02	2.58E-02	N.D.	N.D.
N.D.	N.D.	1.00E-01	1.28E-02	N.D.	N.D.
N.D.	N.D.	1.45E-01	1.16E-02	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

SOURCE TERM 2 OF 2:

1 g Pu, 10 min, ground-level release, RFP met data, with fire

RESULT NAME = POPULATION DOSE (SV)

L-EDEWBODY TOT LIF

0-80.5 KM

PEOPLE FRACTION = 1.0000

OVERALL		EMER. RESP. # 1		CHRONC RESULTS	
X	PROB>=X	X	PROB>=X	X	PROB>=X
1.00E-06	1.00E+00	1.00E-07	1.00E+00	1.00E-06	1.00E+00
2.00E-06	1.00E+00	2.00E-07	1.00E+00	2.00E-06	1.00E+00
3.00E-06	1.00E+00	3.00E-07	1.00E+00	3.00E-06	1.00E+00
5.00E-06	1.00E+00	5.00E-07	1.00E+00	5.00E-06	1.00E+00
7.00E-06	1.00E+00	7.00E-07	1.00E+00	7.00E-06	1.00E+00
1.00E-05	1.00E+00	1.00E-06	1.00E+00	1.00E-05	1.00E+00
2.00E-05	1.00E+00	2.00E-06	1.00E+00	2.00E-05	1.00E+00
3.00E-05	1.00E+00	3.00E-06	1.00E+00	3.00E-05	1.00E+00
5.00E-05	1.00E+00	5.00E-06	1.00E+00	5.00E-05	1.00E+00
7.00E-05	1.00E+00	7.00E-06	1.00E+00	7.00E-05	1.00E+00
1.00E-04	1.00E+00	1.00E-05	1.00E+00	1.00E-04	1.00E+00
2.00E-04	1.00E+00	2.00E-05	1.00E+00	2.00E-04	1.00E+00
3.00E-04	1.00E+00	3.00E-05	1.00E+00	3.00E-04	1.00E+00
5.00E-04	1.00E+00	5.00E-05	1.00E+00	5.00E-04	1.00E+00
7.00E-04	1.00E+00	7.00E-05	1.00E+00	7.00E-04	9.84E-01
1.00E-03	1.00E+00	1.00E-04	1.00E+00	1.00E-03	9.75E-01
2.00E-03	1.00E+00	2.00E-04	1.00E+00	2.00E-03	9.31E-01
3.00E-03	9.91E-01	3.00E-04	1.00E+00	3.00E-03	9.24E-01
5.00E-03	9.75E-01	5.00E-04	1.00E+00	5.00E-03	8.75E-01
7.00E-03	9.29E-01	7.00E-04	1.00E+00	7.00E-03	8.31E-01
1.00E-02	9.20E-01	1.00E-03	1.00E+00	1.00E-02	8.22E-01
2.00E-02	8.67E-01	2.00E-03	9.95E-01	2.00E-02	6.65E-01
3.00E-02	8.62E-01	3.00E-03	9.77E-01	3.00E-02	6.37E-01
5.00E-02	8.10E-01	5.00E-03	9.15E-01	5.00E-02	4.91E-01
7.00E-02	7.32E-01	7.00E-03	9.10E-01	7.00E-02	4.41E-01
1.00E-01	6.44E-01	1.00E-02	9.01E-01	1.00E-01	3.03E-01
2.00E-01	5.14E-01	2.00E-02	8.55E-01	2.00E-01	1.24E-01
3.00E-01	4.23E-01	3.00E-02	8.05E-01	3.00E-01	1.07E-01
5.00E-01	3.29E-01	5.00E-02	7.20E-01	5.00E-01	5.73E-02
7.00E-01	1.98E-01	7.00E-02	6.32E-01	7.00E-01	4.06E-02
1.00E+00	1.04E-01	1.00E-01	6.21E-01	1.00E+00	3.14E-02
2.00E+00	5.51E-02	2.00E-01	4.52E-01	2.00E+00	1.18E-02
3.00E+00	4.26E-02	3.00E-01	4.04E-01	3.00E+00	1.18E-02
5.00E+00	2.20E-02	5.00E-01	2.16E-01	5.00E+00	6.82E-03
7.00E+00	4.14E-03	7.00E-01	1.38E-01	7.00E+00	4.14E-03
1.00E+01	1.20E-03	1.00E+00	7.58E-02	8.97E+00	1.20E-03
1.30E+01	1.20E-03	2.00E+00	2.58E-02	N.D.	N.D.
N.D.	N.D.	3.00E+00	1.28E-02	N.D.	N.D.
N.D.	N.D.	4.63E+00	1.16E-02	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
N.D.	N.D.	N.D.	N.D.	N.D.	N.D.

Successful completion of MACCS2 was achieved!

This job required a total of 170.988 CPU seconds

Input processing required 12.469 CPU seconds
 Simulation required 143.410 CPU seconds
 Output processing required 10.109 CPU seconds