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Carl Walske
President

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July 17, 1978

FP 813-7

Mr. Samuel J. Chilk
Secretary of the Commission
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Docketing and Service Branch

Dear Sir:

A Federal Register notice dated March 13, 1978, advised that the Nuclear Regulatory Commission is considering amending its regulations to provide more specific guidance for decommissioning nuclear facilities. This notice invited advice and recommendations on six questions relating to decommissioning. We are pleased to have the opportunity to provide comments on this important subject. This letter reflects comments received from a number of Forum member organizations. Many Forum members have and will be commenting on an individual basis.

The Commission is to be commended for initiating extensive studies and efforts to better define its regulatory policy relative to decommissioning nuclear facilities. However, since it will be a considerable period of time before a significant number of nuclear power plants will be ready for decommissioning, it is extremely important to ensure flexibility in the regulatory process as additional data and information are developed.

In this context, we would like to offer the following suggestions in response to each of the six questions raised in the Federal Register notice:

1. Is it desirable to develop more definitive decommissioning criteria for licensed facilities?

   The need to retain flexibility in the licensing process is a critical factor in determining whether to develop more definitive decommissioning criteria at this time. For this reason, the development of criteria should be an evolving process as additional knowledge and experience is accumulated. The use of guidance documents rather than rule-making procedures should be encouraged as one means to maintain this needed flexibility.

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With respect to a number of aspects of decommissioning, generic criteria are already in existence because of their applicability to the current regulatory process. For example, there appears to be no reason why generic criteria pertinent to radiation exposure standards and ALARA principles should not be applicable to decommissioning activities in the same fashion as other regulated nuclear activities. There are several additional aspects of decommissioning where NRC generic criteria may be desirable and their development requires careful study because of their potential impact on the regulatory process, both at the federal and state level. These might include release of bulk activated metals for recycle, access control, surveillance and administrative procedures. In these areas, the Commission is urged to continue to follow technological advances related to decommissioning activities and to conduct appropriate confirmatory research and development programs to further advance the state-of-the-art of decommissioning technology.

2. Should detailed decommissioning plans be required prior to the issuance of licenses?

   Detailed decommissioning plans should not be required prior to issuing licenses. It is anticipated that nuclear power plants will be operated for a period of 30-40 years. In fact, the Electric Power Research Institute is exploring alternatives that might extend the lifetime of nuclear power plants even further. It is neither practical nor beneficial to require detailed plans for an activity that will not occur until many years in the future. Technological advances and additional expertise can be developed during the intervening period and incorporated into a detailed plan to be prepared at a time closer to the expected decommissioning. Any plans prepared at the licensing stage should be general in nature, but adequate for prudent financial planning and oversight by a state public utilities commission. The current decommissioning information required by NRC from applicants appears to be satisfactory for the purpose of fulfilling appropriate NRC regulatory responsibilities.

3. Should funding or other surety arrangements be required before the issuance of licenses for all cases? If not, which cases?

Funding or other surety arrangements should not be required before the issuance of licenses for nuclear power plants. AIF submitted comments to the Commission on October 7, 1977, in response to a petition by the Public Interest Research Group, et.al. Our recommendations remain the same on this point: (1) mechanisms used by utilities for funding generation facilities are normally within the purview of state regulatory agencies and requirements vary from state to state; (2) NRC is already considering decommissioning costs in the review of applications, including financial ability to operate and decommission the plant; (3) the costs of decommissioning are extremely small when compared with the funds being generated by a utility for future construction and this aspect should not be singled out as a special issue; and (4) "up front" types of funding are not cost-effective means to provide for decommissioning.

These only address nuclear power plants; development of criteria for other nuclear facilities should await completion of generic studies such as the generic EIS for uranium mill tailings and decommissioning of fuel cycle facilities underway at Argonne National Laboratory and at Pacific Northwest Laboratory respectively.

4. What are acceptable criteria for residual levels of radioactivity on materials which can be released for unrestricted use?

The acceptable criteria for residual levels of radioactivity on materials which can be released for unrestricted use should be no different in the case of decommissioning than for any other nuclear activity. The establishment of acceptable criteria for residual levels of radioactivity on materials that can be released for unrestricted use has been the subject of extensive study by industry. More recently the Atomic Industrial Forum completed a contract study entitled, "de minimus Concentrations of Radionuclides in Solid Wastes." A copy of this report is enclosed for your information. The methodology developed in this study may be useful in establishing a minimum level of radioactivity for contaminated material which could be discarded or released without restriction.

5. Proposals have been made to maintain reactors, which have been closed, in protective storage for lengthy periods of time to allow for radioactive decay prior to dismantlement. From the standpoint of determining the impact to future generations, what is an acceptable length of time, if any, after a facility operation ceases before the facility should be decommissioned?

An acceptable length of time following cessation of nuclear power plant operations in which to begin decommissioning activities is dependent on many factors. These include: planning for future use of the site, economics, procedures and funding for maintaining the site in a secure manner, state-of-the art technology for remote disassembly of highly radioactive materials, waste disposal options, etc. In general, protective storage should be permissible for as long as the licensee can justify such storage consistent with these factors. A study of nuclear power plant decommissioning alternatives was completed by AIF in 1976, (AIF/NESP-009). To illustrate a possible option, one of the more promising alternatives discussed in that report involves mothballing followed by a delayed removal and dismantling procedure which suggests a delay period of about 100 years.

Certainly no arbitrary limitation should be imposed on length of protective storage that would preclude the use of such optimum combinations of decommissioning alternatives. Since the utility possession of the facility will remain subject to regulatory oversight, future generations will be fully protected.

6. Should decommissioning criteria extend to buildings, structures and components which have not been contaminated with radioactive materials?

NRC decommissioning criteria should not be extended to buildings or structures and components which have not been contaminated with radioactive material. Since radiological health and safety will not be involved, determinations with respect to these items will primarily relate to subsequent land use and economics. These determinations should not be concerns of the NRC, but are more appropriately within the purview of the utility and local and state regulatory agencies as in similar instances involving fossil plants.

This is particularly true since there is a possibility that the non-radioactive facilities have some potential use in non-nuclear activities.

Thank you for the opportunity to provide comments related to this matter.

Sincerely,

Edwin J. Wiggin
for Carl Walske

CW:hjm
Enclosure

AIF/NESP-016

National Environmental Studies Project

"de minimus" CONCENTRATIONS OF RADIONUCLIDES IN SOLID WASTES

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The opinions, conclusions, and recommendations set forth in this report are those of the authors and do not necessarily represent the views of the Atomic Industrial Forum, Inc., its members, or its consultants.

PREFACE

In a general sense, the term "de minimus" refers to concentrations or quantities of potential pollutants that are present in so minute amounts in a gaseous, liquid or solid waste as to be relatively harmless to man and his environment. In other words, a waste or effluent that meets criteria defining "de minimus" levels should be acceptable for disposal or release without any special precautions or monitoring programs. While wastes and effluents from power reactor operations are generally thought of in terms of their radioactivity content, the concept is equally applicable to such environmental concerns as free residual chlorine, atmospheric and aquatic rejection of waste heat, and the impingement and entrainment of aquatic organisms in cooling water systems.

The concept of "de minimus" concentrations of radionuclides in slightly contaminated solid waste was first brought to our attention about two years ago by several of NESP's sponsors and the Nuclear Regulatory Commission. When funding became available in mid-1977, Nuclear Safety Associates was awarded a contract to investigate existing standards for radioactive materials and other considerations, such as background radiation, for the purpose of identifying criteria that define "de minimus" levels. Once the criteria were defined, the thrust of the study was to develop and apply a generic methodology that could be used for determining whether or not certain slightly contaminated solid wastes were suitable for a "de minimus" radioactivity-level classification.

It is important to note that it was not intended for this investigation to include an evaluation of the overall acceptability or appropriateness of various existing radiation standards or guidelines, such as 40 CFR Part 190 and Appendix I to 10 CFR Part 50, but rather, to use current

regulations as a basis for defining reasonable "de minimus" levels. Hence, it should not be inferred by the reader that the results of the study tacitly endorse the regulations considered. Also, the criteria are presented as a suggested approach to defining "de minimus" levels and do not necessarily represent a consensus position of the nuclear power industry,

For this initial NESP investigation of the "de minimus" concept, PWR spent secondary-side powdered resin was selected as a specific and timely subject that could be used to demonstrate the development and application of a generic methodology. The study was limited to spent powdered resin because of budgetary constraints and the fact that the spent resin example would suitably serve the purpose of illustrating the basic concept. It was found that the methodology is applicable to other solid wastes, e.g., slightly-contaminated soils, dredge spoils and the like. However, because the pathways for dose to man evaluated in this work were selected on the basis of solid waste, the methodology is not complete in terms of its application to wastes other than solids. In the particular case of the "trash" category of solid wastes, the methodology is probably incomplete because of the possibility of incineration and the fact that the methodology does not include this kind of airborne pathway to man. Nonetheless, this should not be interpreted as a major shortcoming in the methodology, because once the user understands its application to solid waste, he can readily include analyses of additional pathways that are relevant to the particular waste being examined.

The limiting radionuclide concentrations for solids presented in this work are thought to be generic and independent of site-specific variables.

For this study, pathways and assumptions were selected in order that variations in individual site characteristics would not appreciably alter the findings. For example, the assumptions made for the "sanitary landfill-leaching into watercourse" pathway analysis, which would usually be considered quite site dependent, were sufficiently conservative that even the limiting radionuclide concentrations stipulated for this pathway can be considered independent of site-specific features. It is also important to recognize that the primary criterion identified in this study for determining "de minimus" levels, which is 1 mrem/year to an individual, was selected on a very conservative basis, and that higher levels of contamination are very likely to be appropriate for some applications of the concept, particularly those involving more controlled waste disposal conditions.

Philip Garrett
Project Manager
National Environmental Studies Project

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1.0 INTRODUCTION

In 1977, the National Environmental Studies Project of the Atomic Industrial Forum established a task force to develop the scope of a study aimed at determining levels of radioactivity which could be considered "de minimus", i.e., levels which could be considered "non-radioactive" and such that materials at or below these levels could be released or discarded without restriction. As a result of the work of this task force, Nuclear Safety Associates was commissioned by the Atomic Industrial Forum to carry out such a study, to develop specific recommendations for quantitative "de minimus" levels using spent powdered ion-exchange resins from PWR secondary systems as an example, and to supply the technical and scientific bases for determining and justifying the levels selected.

In the development of the "de minimus" values reported herein, the following basic steps were used:

- Basic radiation protection criteria were identified. Clearly there is a direct relationship between the quantity or concentration of radioisotopes which may be released by any means and the degree of protection which is to be provided to members of the public. Therefore, it is first necessary to establish what the desired degree of protection is. The selection of this criterion is discussed in Section 3 of this report.
- Pathways by which released activity could reach man were identified and described. The major modes by which man may be exposed to ambient radioactivity are: ingestion, inhalation, and direct irradiation. There are also a number of transport mechanisms by which radioactive material may move in the

environment and thus reach man. Some of these are: suspension of solid particles into air, surface runoff with water, transport by groundwater, and physical transport into situations wherein food products may be raised in proximity to the radioactivity. A matrix of exposure pathways was set up to describe all practicable ways by which exposure of man might occur. A discussion of the pathways investigated is given in Section 4.2.

- For each pathway and for each isotope the limiting concentration which allows the selected radiation protection criterion to be met was calculated. For each radionuclide the limiting pathway was determined and the radionuclide limit was set, individually, based upon the most restrictive mode found for that nuclide. A discussion of this calculational technique and of the computer code developed to carry it out is given in Section 4.3. The extensive calculational results are summarized in Section 4.4.
- Consideration was given to whether application of the principle as low as is reasonably achievable (ALARA) would result in limits lower than those resulting from the calculations identified above. It was concluded that ALARA did not result in lower limits than those calculated herein.
- The "de minimus" limits discussed in Section 4 are then applied to a specific case—the disposal of PWR secondary resins. In a specific case, it it possible to compare activity levels to the "de minimus" levels calculated herein and to determine the key radionuclides which dominate that specific case. This is discussed in Section 7.1. Finally, the practicality of the specific application is addressed by considering whether the

normally available analytical capability is able to determine these key isotopes at the required low levels. This is considered in Section 7.2.

The result of this study is the determination within defined conditions of concentrations of essentially all isotopes of interest to the nuclear industry which can be considered "de minimus." The application of the general method to a specific case is illustrated. It is believed that the method is applicable to a wide variety of materials and situations.

2.0 CONCLUSIONS

The major conclusions from this investigation are:

1) A suggested appropriate level of protection to be used in establishing "de minimus" concentrations of materials containing trace amounts of radionuclides is a maximum total body dose of 1 mrem/year, or a maximum dose to any organ of 3 mrem/year, to any individual. This level is suggested by the application of the 10 CFR Part 20 provision which permits ignoring isotopic contributions which individually contribute less than 10% to the total dose and which collectively contribute less than 25% to the design guide levels of 10 CFR Part 50, Appendix I.

2) For wastes such as PWR secondary resins disposed in soils, it has been shown that four isotopes, Cs-137, Cs-134, Co-60, and Co-58 clearly dominate the dose calculations. Two of these, Co-60 and Cs-137, could be used as "keys" to establish compliance with the suggested limits.

3) The concentration levels required to meet the suggested "de minimus" concentrations are in the range of one pCi/gram. For the "key" isotopes, Co-60 and Cs-137, these concentrations are readily measureable with equipment normally available at nuclear reactor sites.

3.0 RADIATION PROTECTION CRITERIA

3.1 Introduction

Appropriate radiation protection criteria are prerequisite to the determination of "de minimus" radionuclide concentrations in any radioactive material. A direct relationship will exist between the concentrations of radioisotopes which may be disposed of without specific controls, i.e., be considered "de minimus" and the degree of protection provided to members of the public.

Existing radiation protection standards are not applicable to routine unrestricted disposal of slightly contaminated nuclear materials. They do, however, serve as references from which to derive "de minimus" criteria compatible with regulatory standards.

The potential for individual and population exposure via any single source should be considered in relation to exposures from other sources, particularly from naturally existing ones. The relative benefits of providing protection against radiation from a specific source may also be judged in perspective with variations in personal exposures from background sources.

Therefore, the radiation protection criteria appropriate for determining the concentrations of radioactivity in slightly-contaminated materials which may be disposed of in an unrestricted manner must be compatible with current or revised standards for protection against radiation. They should also retain perspective in relation to the risk of health effects from natural environmental exposures and variations therein.

3.2 Natural Background Radiation Exposures

The significance of any added exposure potential associated with introduction of radioactivity into the environment should be considered in relation to natural environmental levels of radiation and variations therein. A review of natural sources of radiation exposure and their variability can provide guidance and perspective for selecting the boundary of "de minimus" dose rates from release of radioactive material into the environment.

Sources of Natural Radiation

Naturally occurring radiation in the environment originates from cosmic rays, radionuclides produced by cosmic rays, and from primordial radionuclides in the earth. In the United States, the air dose rates due to cosmic rays vary from about 27 to 95 mrad/yr and the population weighted mean air dose rate has been estimated to be about 29 mrad/yr (NC75). Outdoor exposure rates due to terrestrial radioactivity vary from about 12 to 90 mrad/yr in the US and the population weighted mean is about 44 mrad/yr (NC75).

People are also exposed to natural radiation by internally deposited radionuclides that have been inhaled or ingested as well as to external irradiation. Typical dose equivalent rates to a representative US resident from naturally occurring sources are provided in Table 3-1.* The estimated dose rate from cosmic rays includes a ten percent reduction to account for structural shielding. Irradiation by primordial terrestrial radioactivity includes a 20-percent reduction for shielding by housing and

* Adapted from Ref. NC 75.

a 20 percent reduction for self-shielding by the body. The dose to the lung from inhaled radioactivity is tabulated separately; doses to other tissues from inhaled radioactivity are included with other primordial radionuclides in the body. Estimated doses to the gastrointestinal tract do not include any contribution from radioactivity in the contents of the tract.

Environmental Variations

Individuals and population subgroups within the United States experience dose equivalent rates which vary widely from the average. Large segments of the population experience appreciably different natural exposures. External terrestrial dose equivalent rates experienced by people indoors range from about 15 mrem per year on the Atlantic and Gulf Coast plain to 30 mrem per year in mid-continent and to about 55 mrem per year along the Colorado Plateau (Oa72). Cosmic ray dose equivalent rates experienced by the population range from 26 mrem in Florida to about 50 mrem per year in Denver, Colorado (NC75). Thus natural external radiation doses to large groups in the United States population vary from about 41 to 105 mrem per year by geographic location alone.

Most of the variation in dose due to radionuclides in the body results from variations in Ra-226 in drinking water and in the lung from Rn-222 progeny.

A typical United States resident receives about 16 mrem per year bone dose and about 0.2 mrem per year to soft tissue from ingested radium (UN72). Even if the radium concentration in community water supplies does not exceed the current regulatory limit of 5 pCi/ℓ (EPA76),

dose rates experienced by users could be as much as 1 mrem per year to soft body tissue and about 150 mrem per year to bone from drinking water alone.

An average dose to the lung of about 100 mrem per year from radon progeny inhaled in dwellings has been attributed to construction materials, type of construction, ventilation, and radioactivity in land beneath (NC75). Variations among these influential factors cause lung dose equivalents to vary by a few hundred millirem per year among limited population groups in the United States.

Throughout history, mankind has been exposed to roughly these levels of naturally occurring radiation. In some other parts of the world exposures have been even higher. For instance, along the southeastern coast of India, where thorium-bearing monazite sand is abundant, external exposures to residents from natural radioactivity in the sandy soil ranges up to about 2000 millirads per year. In some towns along the coast of Brazil, external exposures from monazite sand in the soil average 550 millirads per year within a range from 90 to 2800 millirads annually (UN72). Even at these rates, effects on man's health or development have not been detected.

Variations According to Living Habits. Differences in personal living habits also affect exposure to naturally occurring radiation and radioactive material. Within a given locality the construction materials and style of buildings influence indoor radiation exposure rates. Gamma exposure rates in masonry (Oa72) and in slab-on-grade dwellings (Fla77) have been observed to be about the same as in natural outdoor areas surrounding the dwellings. But in wood frame dwellings, gamma exposure rates ranging from 70 to 80 percent of outdoor

levels and averaging closer to 70 percent have been observed (Oa72). Yeates (Ye72) measured gamma radiation intensity reductions of about 25% on the first floor and about 50% on the second floor of wood frame houses. Overall, the difference in direct radiation exposure to persons living and working in wood frame buildings rather than in concrete or masonry buildings can be about 10 millirem per year.

Lung exposure to radon and its progeny may be affected significantly by living habits. For instance, concentrations of Pb-210 and Po-210, both long-lived progeny of Rn-222, have been found to be about 2 or 3 times higher in the lungs and ribs of cigarette smokers than in non-smokers (Ra64, UN72). This amounts to 6 to 9 millirem per year additional dose to the lungs of a smoker, a 5 to 7 percent increase in total lung dose by comparison with a typical non-smoker. If natural gas is used in a residence, lung doses will typically increase by about two percent, i.e., about two millirem per year, as a result (Ba73). Perhaps the greatest influence on naturally occurring lung exposures is ventilation practices in dwellings which alone can influence radon and radon progeny concentrations in a house by a factor of as much as ten (Wi77).

Another activity which affects exposure to naturally occurring radiation is air travel. At the jet cruising altitude, about 33,000 to 39,000 feet, the dose equivalent rate due to cosmic rays is about 0.3 to 0.5 mrem per hour. Based on this, the United States population averaged dose equivalent from commercial air travel is about one millirem annually. However, if a person travels more frequently, e.g., two trips per month of four hours duration each, his annual dose equivalent will be increased by about 30 to 50 millirem.

Where one vacations may also influence his annual radiation exposure. Spending a week skiing in Colorado will deliver about 1.5 millirem more than a week at an Atlantic beach, for instance.

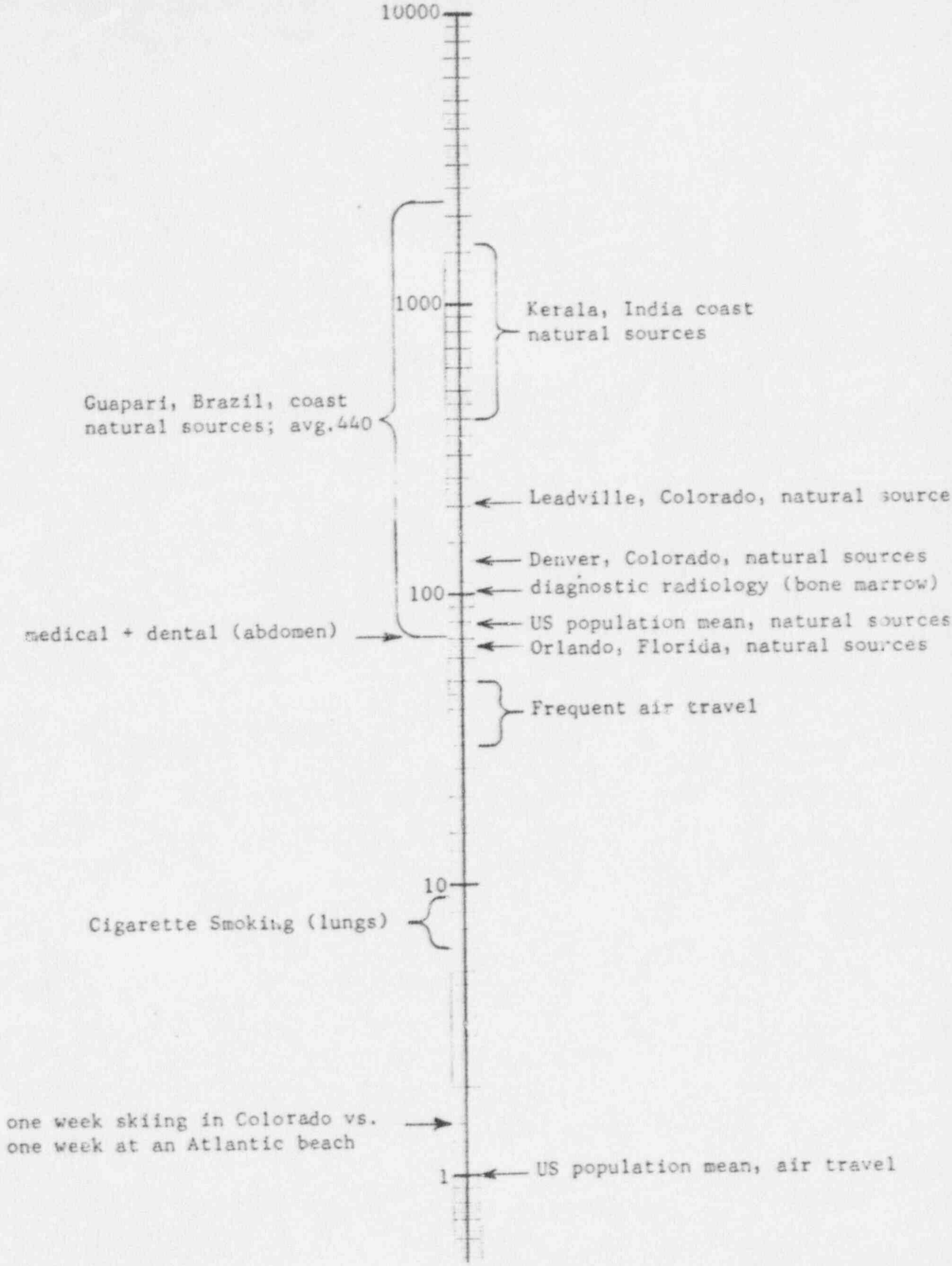
These examples illustrate the effects personal living habits can have upon exposure to naturally occurring radiation and radioactive material. The range and variation in human exposure to natural radiation as consequence of living habits and locations are illustrated in Figure 3-1.

Implication of Natural Background Exposure

Knowledge of population exposure rates from naturally occurring radiation and radioactive materials provides a rational basis for selecting appropriate standards for unrestricted disposal of slightly radioactive material.

It should be remembered that the doses from natural radioactivity and, to a large extent, from medical administration, affect the entire United States population. Conversely, the number of people exposed to "de minimus" concentrations of radioactivity will be small. In fact, a limit on the potential dose to maximally exposed persons should be an adequate criterion for determining appropriate "de minimus" radionuclide concentrations. At such a low individual dose rate, a cost-benefit interpretation based on an estimate of population integrated dose equivalent would be of questionable value in providing guidance (IC73, NC75a).

The range and variation in exposures to natural sources of radiation experienced by the population of the United States suggests "de minimus" dose rate of a few millirem per year to individual members of the



Units: millirem/year

Figure 3-1. Personal Dose Rates of Ionizing Radiation from Naturally Occurring or Unregulated Sources

population are appropriate. For example, three millirem total body dose per year is well within the variation among residents of a given area and is only a few percent of the variation among large groups of people in different parts of the United States.

3.3 Unregulated, Man-made Radiation Exposures

The largest fraction of the man-made radiation exposure to residents of the United States is now administered in the practice of medicine and dentistry. Public exposure from this source exceeds that from other man-made sources by ten to one hundred times. Medical diagnostic radiology accounts for at least 90 percent of the man-made radiation exposure. Estimates based on the 1970 X-Ray Exposure Study were that the per capita mean active bone marrow dose to adults in 1970 was 103 millirem from all diagnostic radiology procedures (Sh76). The mean abdominal dose per capita in the US population in 1970 from medical and dental radiation was estimated to be 72 millirem (Gi72). Medically administered radiation doses vary widely among individuals, of course. These estimates of localized doses are roughly equal to the average total body dose a US resident receives annually from natural radiation sources.

3.4 Existing Regulations

As a first step in establishing radiation protection criteria associated with "de minimus" releases, the existing regulations were reviewed. Some aspects of these regulations could be interpreted as establishing "de minimus" concentrations of radioactive materials for disposal. These relevant Federal regulations which influence the choice of radiation protection criteria for establishing "de minimus" concentrations were examined.

Federal Regulations, Title 10, Part 20

The maximum exposure in unrestricted areas permitted by 10 CFR Part 20 is 500 mrem per year to the whole body of any individual (10 CFR Part 20.105). For a population group, the exposure from radioactive materials in effluents may not exceed that which would occur if the group were continuously exposed to air or water concentrations containing one-third of the unrestricted Maximum Permissible Concentration (MPC) (10 CFR Part 20.106). These limitations are subject to the further constraint that the exposure must be as low as is reasonably achievable (10 CFR Part 20.01).

Part 20 also restricts the method of waste disposal (10 CFR Part 20.301-305). Disposal into a sanitary sewage system is not allowed unless

1) the waste is readily soluble or dispersible in water,
2) the daily discharge is less than the larger of:
    a) the quantity which if diluted by the average daily quantity of sewage would result in an average concentration equal to the unrestricted MPC in water, or
    b) ten times the quantity of such material specified in Appendix C of 10 CFR Part 20.
3) the monthly average discharge concentration is below the unrestricted MPC in water, and
4) the gross discharge is less than 1 curie per year.

Burial of waste in soil is restricted by 10 CFR Part 20.304 to 12 burials per year or less at a minimum depth of 4 feet with successive burials separated by distances of at least 6 feet. The total quantity buried at any one location and time may not exceed, at the time of

burial, 1000 times the amount specified in Appendix C of 10 CFR Part 20. The Appendix C values for several of the key isotopes are:

Cs-134	1 microcurie	Sr-90	0.1 microcurie
Cs-137	10 microcuries	Ra-226	0.01 microcurie
Co-60	1 microcurie		

Thus the inventory at any disposal location may be 1 millicurie of Co-60 or Cs-134 or 10 millicuries of Cs-137. Since for mixtures, the sum of the ratios of the quantity present to the inventory allowed must be less than or equal to one, the actual amounts of these isotopes allowed would be lower. For mixtures of beta emitters of unknown composition, the total inventory limit would be about 100 nanocuries.

There are no specific guidelines in 10 CFR Part 20 pertaining to disposal at sea or to incineration. They are handled on a case by case basis as provided for in Parts 20.302 and 20.305.

Federal Regulations, Title 10, Part 30

A person may receive, possess, use, transfer, own, or acquire materials containing byproduct radioactive material and be exempt from the requirements for a license providing the activity concentrations of byproduct material do not exceed those listed in 10 CFR Part 30.70 Schedule A (see 10 CFR Part 30.14). However, the introduction of by-product material in exempt concentrations into materials and transfer of ownership or possession of it does require a license in accord with 10 CFR Part 32.11. Some limitations are stated in Part 32.11(c).

Federal Regulations, Title 10, Part 50 Appendix I

Appendix I to 10 CFR Part 50 provides numerical guides for reactor design objectives and limiting conditions of operation. The applicant

must provide reasonable assurance that the following design objectives will be met for each reactor. Total annual radioactive releases in liquid and gaseous effluents above background from a single light-water-cooled nuclear reactor must not cause the estimate of annual dose or dose commitment to any person in an unrestricted area to exceed:

1) 3 mrem to the total body or 10 mrem to any organ as a result of activity in liquid effluent,

2) 5 mrem to the total body or 15 mrem to the skin due to activity in gaseous effluent, and

3) 15 mrem to any organ from radioactive iodine and radioactive material in particulate form released to the atmosphere.

In addition to meeting these design objectives, the radwaste system must include all items of reasonably demonstrated technology, that when added to the system sequentially and in order of diminishing cost-benefit return, can for a favorable cost-benefit ratio effect reductions in dose to the population reasonably expected to be within 50 miles of the reactor. The interim value of $1000 per total body man-rem and per man-thyroid-rem is currently accepted in the cost-benefit analysis.

Operating reactor guidelines are set at one-half of the design objective annual exposure based on actual releases in effluents during any calendar quarter. They represent design objectives for releases to the environment which are controlled and monitored prior to release and are the object of environmental monitoring after release.

These requirements apply to liquid and gaseous effluents of a single light water reactor, but they are not directly applicable to solid wastes. However, they do provide guidance in determining "de minimus" levels for solids.

Since "de minimus" wastes would not be subject to environmental surv lance after disposal, lower activity concentration limits in "de mir wastes than in reactor effluents may be justified, even though, in v of variations in natural radiation background levels, Appendix I des guides may be too low in the first place.

Federal Regulations, Title 10, Part 71

Because it is likely that "de minimus" waste will have to be tr ported, it is important to recognize the requirements of 10 CFR P rt for special packaging. Compliance may be guaranteed is the activity concentration is less than 2 nanocuries per gram or if each package contains less than 50 millicuries, the exempt quantity for mixed fis products. Assuming 50 millicuries are packaged in a 55-gallon drum a density of 1.5 gram per cubic centimeter, the activity concentrati... be as high as 160 nanocuries per gram. As will be shown later, this limitation is higher than that calculated herein as "de minimus."

Federal Regulations, Title 40, Part 190

The maximum annual exposure allowed by 40 CFR Part 190 to a memb of the public as the result of planned discharges of radioactive mate to the general environment from uranium fuel cycle operations is 25 m to the whole body, 75 mrem to the thyroid, and 25 mrem to any other o These limitations exclude operations at waste disposal sites, but do r specifically exclude waste itself. However, the much lower limits of 40 CFR Part 190 make it clear that any attempt to use the exposure lin of 10 CFR Part 20 as a criterion for "de minimus" waste disposal will unacceptable.

Proposed Federal Guidance on Transuranium Elements in the Environment

The Environmental Protection Agency has proposed Federal radiation protection guidance on limits of dose to persons exposed to transuranics in the environment as a result of existing or possible future unplanned contamination (EPA77). The text of the proposed guidance follows:

1. The annual alpha radiation dose rate to members of the critical segment of the exposed population as the result of exposure to transuranium elements in the general environment should not exceed either:

a. 1 millirad per year to the pulmonary lung, or and

b. 3 millirad per year to the bone.

2. For newly contaminated areas, control measures should be taken to minimize both residual levels and radiation exposures of the general public. The control measures are expected to result in levels well below those specified in paragraph one. Compliance with the guidance recommendations should be achieved within a reasonable period of time.

3. The recommendations are to be used only for guidance on possible remedial actions for the protection of the public health in instances of presently existing contamination or of possible future unplanned releases of transuranium elements. They are not to be used by Federal agencies as limits for planned releases of transuranium elements into the general environment.

One "millirad per year to the pulmonary lung" is meant to be the equilibrium dose rate resulting from chronic inhalation. The corresponding dose equivalent rate for alpha emitting transuranics is 20 millirem per year.

3.5 Selection of Dose Limits Appropriate for "de minimus" Disposal Concentrations

Concentrations of radionuclides which may be considered "de mini are directly related to dose limits which are appropriate for unrestr disposal. That is, selection of such limits should be guided by crit which reflect an acceptable level of health protection.

A rational conservative criterion for selecting "de minimus" dos limits is to select the level below which the dose rate to maximally exposed individuals is insignificant in comparison to the dose rate typically experienced by a member of the population from naturally occurring radiation and radioactivity. Considering the natural dose rate distribution in the USA, a few millirem per year more or less, $\pm$ for instance, is not significant in comparison with the dose rate dis tribution from natural sources.

A practical criterion is that the dose limits selected must be compatible with existing radiation protection standards and regulatic or must suggest appropriate revision of the regulations. To this enc practicality dictates the "de minimus" dose rate limit be no more th 10 CFR Part 50, Appendix I design objectives and possibly less. That is, to be consistent with existing regulations, the "de minimus" dose limit should not exceed 3 (liquid) to 5 (airborne) millirem total boc dose equivalent per year to individual members of the public.

Practical guidance for selecting "de minimus" dose levels can be deduced from 10 CFR Part 20, Appendix B. According to Appendix B, footnote 5, a radionuclide in a mixture may be ignored it if is prese

in less than 0.1 of its maximum permissible concentration and if the su of the fractional MPC of all radionuclides considered as not present in the mixture does not exceed 0.25. A "de minimus" dose rate limit is th suggested by the combination of the Appendix I design objectives and th 0.25 factor of disregard given in 10 CFR Part 20, Appendix B. Together 0.25 of 3 to 5 mrem per year total body dose is roughly one mrem per year. Consistent with 10 CFR Part 20, the corresponding individual org dose limit would be 3 mrem per year. One millirem per year to the tota body or 3 to individual organs is hardly significant in relation to dos received from natural background sour es.

To further illustrate its insignificance, assuming the linear non-threshold dose-effect relation and the dose-to-risk estimates presented in the BEIR Report (BEIR72) hold at such a low dose rate, the additiona risk associated with continuing doses of one mrem per year is estimated to be about one additional chance of adverse health effect in ten milli person-years of exposure. It should be acknowledged that this extremel low estimate of hypothetical risk is probably an unrealistic overestima of actual risk and may not be useful for other than illustration (see NC75a, pp. 3-4). Nevertheless, it is insignificant in relation to many demonstrated risks a typical resident experiences in the course of dail living in the US. By comparison, the US mortility rate in 1973 attributed to motor vehicles was 265 per million person-years and that attributed to falls was 80 per million person-years.

Therefore, one millirem per year total body dose equivalent and 3 millirem per year single organ dose equivalent in excess of the natural radiation background are suggested as dose equivalent rates at and bel

which the dose rate to persons maximally exposed to radioactivity i: solid waste should be acceptable as "de minimus." This radiation protection criterion was selected for use in connection with this st If higher values than one millirem total body and 3 millirem to an o are selected as "de minimus" dose limits, then the concentrations pr sented herein would be scaled upward directly.

Table 3-1

Summary of Representative Dose Equivalent
Rates in the USA from All Naturally Occurring Radiation Sources[a]

Source	Dose Equivalent Rates (mrem/yr)				
	Gonads	Lungs	Bone		GI Tract
			Surfaces	Marrow	
Cosmic Radiation[b]	28	28	28	28	28
Cosmogenic Radionuclides	0.7	0.7	0.8	0.7	0.7
External Primordial Radionuclides[b]	26	26	26	26	26
Primoridal Radionuclides in the Body	24	21	58	22	21
Inhaled Radionuclides[c]	—	106	—	—	—
	79	182	113	77	76

[a] Adapted from NCRP Report No. 45, Table 44.

[b] Indoor dose equivalent rates.

[c] Doses to organs other than lung included in "Primoridal Radionuclides in the Body."

4.0 METHODOLOGY EMPLOYED

In this study, solid wastes with very low activity concentr are postulated to be placed in the environment with and without ordinarily imposed by regulations applicable to disposal of non-active solid wastes. For voluminous solid material, land dispos anticipated. One objective of this study was to develop a metho to quantify the relation between the "de minimus" radiation prot criteria selected and the corresponding limiting concentration o radionuclide in solid waste which allows the radiation protectio criteria to be satisfied. The relation would be determined by e mental pathway analyses.

4.1 Disposal Scenarios

During the study, several disposal scenarios were considered the objective of selecting those which are likely to have the mos potential for maximum personal exposure to radioactive material i the environment from the discarded solid waste. Examination of p environmental pathways and survey calculations suggested that lan with residents on the disposal site probably leads to the maximum thetical personal exposure. It should be noted that neither disp sea nor a disposal scenario that primarily produces airborne disp e g., incineration, was considered. Only the two scenarios which to have the most potential for maximum individual exposure were e in detail. In one, identified as the "sanitary landfill" scenaric card into a sanitary landfill with ordinary operating procedures i was postulated. Construction of a dwelling on the sanitary landfi assumed to occur five years after operation of the sanitary landfi

ended. In the other scenario, termed "fill wanted" disposal, unregulat use of the solid waste as landfill in a residential setting was postulat In the letter case, a dwelling was assumed to exist on the landfill immediately after placement of the waste.

4.2 Environmental Pathways

An array of possible environmental pathways is associated with eacl disposal method. In this study, one requirement was to conceive feasibl disposal scenarios with which the most important pathways are associatec and to evaluate all of the associated pathways in a way which determines the critical pathway for each radionuclide in discarded waste.

The application of the methodology developed in this study was confined to land disposal of a homogeneous, bulk solid waste, namely spent, powdered ion exchange resins from PWR secondary systems.

Man's most direct radiation exposure from discarded solid waste could be by irradiation during or after its placement in a landfill. Ingestion of a small amount of waste or inhalation of material suspendec in the air can also be direct pathways.

Other exposure pathways involve environmental transport mechanisms. Digging in a landfill may redistribute some of the material and cause some suspension in the air. If food crops are grown on a landfill that has not been covered adequately, plant uptake of radionuclides from the fill material may establish a link to man via vegetation and/or meat. Leaching followed by surface or ground water migration or erosion and transport by wind or water all create additional pathways to man where contact by external irradiation, ingestion, or inhalation are possible.

The evaluation of many environmental pathways is not heavil dependent upon site specific data. The evaluation of pathways i hydrologic transport, namely groundwater migration or a surface is dependent on values of site related variables, however. To a site dependency, surface water and ground water migration were n modeled. Instead, a conservative choice of one percent of radio in waste discarded was assumed to leach directly into a watercou year. For dilution a stream flow of 10^4 liters per second was as The effect of any other stream flow on estimated doses would be i inverse proportion to the nominal stream flow assumed.

Potential dose equivalent rates associated with the sanitary fill and the fill wanted disposal scenarios were evaluated with e mental pathway models suggested in Regulatory Guide 1.109, Revisi (RG 1.109) except as mentioned for hydrologic pathways. Specific assumptions and values of variables assigned in the pathways eval are stated in Appendix B for each pathway examined in the "sanita fill" and "fill wanted" disposal schemes. Otherwise, values sugg Regulatory Guide 1.109 for individuals were assigned. An example specific assumptions, taken from Case I-A for the evaluation of pc lated leaching of radionuclides from solids in a sanitary landfill watercourse is shown in Table 4-1. Detailed assumptions used in a other cases and the computed results of the pathway analyses are i in Appendix B.

Bulk solid waste containing traces of radioactivity offers th potential for individual exposure when used as landfill around a r Generally, the most direct exposure pathways were found to offer t greatest potential for exposure of persons nearby.

Ordinarily, radioactive material released as effluents is not assumed to perturb natural background exposure rates. However, bu solids which, in isolation, contain "de minimus" concentrations of radioactivity, may actually reduce natural background exposure rat at the disposal location by shielding, displacing, or diluting the naturally radioactive environmental media (soil, etc.). Since the criterion selected for determining a "de minimus" concentration li i.e., natural background exposure rate plus an increment of one mi total body or 3 millirem/yr to any single organ, is so restrictive perturbation of the natural background exposure rate at the dispos location may be a significant factot. For each millirem/yr reduct in natural background exposure rate caused by the presence of soli wastes, the contribution of the subject waste to the total exposur rate (from background plus waste) could conceptually be allowed to increase by one millirem/year without causing an environmental imp in excess of that corresponding to the criterion. Notwithstanding likelihood that disposal of "de minimus" wastes may well result in diminution of natural background radiation, no credit for this fac was taken in these calculations.

4.3 Calculational Technique

The general approach used to determine the "de minimus" conce trations was to first calculate the limiting radionuclide concentr for each pathway separately. Then for every nuclide and pathway c ered, a search of all pathways was conducted to find the pathway w resulted in the most restrictive disposal limitation for each radi nuclide. These values represent the solution to the problem of de mining "de minimus" concentrations.

A computer program was written to execute the above general cedure. Each pathway was represented by a subroutine which calc the limiting concentrations for that pathway for the values assi variables. The limiting concentration was determined for each n if it were the only nuclide contributing to the dose rate with t exception that the dose rate associated with daughter products w against the parent nuclide. This was accomplished by assuming t concentration of each radionuclide in the waste was 1 pCi/g. Th pathway, the dose equivalent rate associated with each radionucl its accumulated decay products at the time of exposure was compu Each computed dose equivalent rate and the associated activity c initially in the waste were scaled up or down to match the appro "de minimus" dose rate limit. In order to conservatively estima radioactive decay products were assumed to be transported with th parent in every pathway until taken into plants or animals. At t point, the stable element transfer data or bioaccumulation data i Regulatory Guide 1.109 were used where appropriate. Detailed equ used to evaluate each exposure pathway are given in Appendix A.

After the limiting concentrations for each pathway were calc the program selected the critical pathway of each nuclide. Final table was generated, e.g., Table 4-3, which shows the limiting co for each critical pathway and the "de minimus" concentration limi the associated most limiting pathway.

Figure 4-1 is a summary diagram of the method of determining critical pathway and deriving the "de minimus" concentration limi radionuclide from among any postulated set of disposal scenarios environmental pathways.

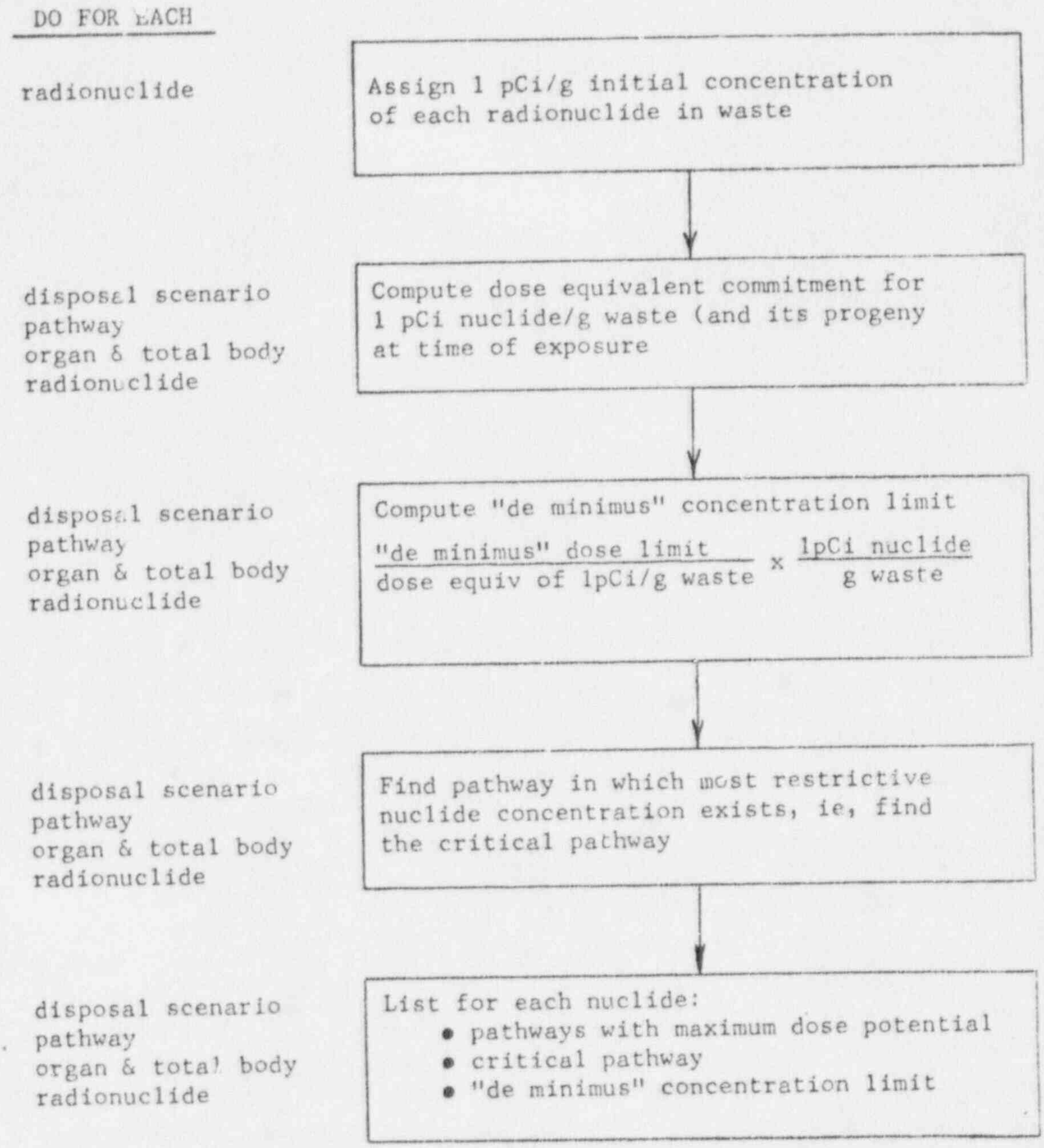


Figure 4-1 Summary Diagram of Method of Determining "de minimus" Radionuclide Concentration Limit

4.4 Results of Calculations

Individual Pathway Evaluation

Each disposal scenario-pathway-receptor (total body or or combination was computed independently to determine the "de mi concentration limit of each radionuclide in that case. Table an example of the results of calculations for one case, leachi a sanitary landfill into a watercourse with a transit time of Quantities assigned to environmental variables in the computer listed at the end of Table 4-2 and in Table 4-1.

A total of 143 separate disposal scenario-pathway-organ c were evaluated in four series of cases. They are identified b

Series	Disposal Scenario	Receptor of Do
I	Sanitary Landfill	Whole Body
II	Fill Wanted	Whole Body
III	Sanitary Landfill	Critical Orga
IV	Fill Wanted	Critical Orga

Computational results of 15 of these separate cases appear in In each of the tables, the limiting concentration of each radi is expressed in units of microcurie per gram. Entries appeari 1E07 μCi/gm represent concentrations greater than 1×10^7 μCi/ waste. This value, equal to 10 Ci/gm, was chosen arbitrarily upper cutoff value.

Summary of Most Limiting Cases

After the limiting activity concentration of each radionu each disposal scenario-pathway-receptor combination was calcul program selected the critical pathway of each radionuclide ass with any of the combinations evaluated. Finally, a table was

e.g., Table 4-3, which shows the limiting concentration, i.e., the activity concentration of a radionuclide which may produce the "de minimus" dose limit, in each of the most important pathways associat with any of the disposal scenarios evaluated. The table also lists "de minimus" concentration limit of each radionuclide along with its critical pathway. The tabulated values of the "de minimus" concentr limits, in Table 4-3 for instance, represent a general solution to t problem of determining "de minimus" concentrations based upon the mo restrictive disposal scenarios and environmental pathways conceived.

The results shown in Table 4-3 are repeated in Table 4-4 but wi the nuclides arranged in order of increasing "de minimus" concentrat: limit.

The lowest "de minimus" concentration limits is that of Ra-226, its critical pathway is through a child eating some of the discarded resin. However, it is not a significant or limiting constituent of reactor wastes. The next most nearly limiting radionuclides, all of which have "de minimus" concentration limits below the pCi/gram level

Nuclide	Limiting Pathway
Co-60	Fill Wanted—Ground Exposure
Sr-90	Fill Wanted—Food Grown
Ag-110m	Fill Wanted—Ground Exposure
I-129	Fill Wanted—Food Grown

The "de minimus" concentration limits of every other radionuclide in reactor wastes is greater than 1 pCi/gram.

The use of the "fill wanted" scenario (Series II and IV) results in limits somewhat lower than would occur if it were assumed that the "de minimus" waste were disposed of in a sanitary landfill. If the

pathways to man are limited to those associated with disposal to a to a sanitary landfill, the activity concentration limits are shown in Table 4-5. The same values are shown in Table 4-6 except there the nuclides appear in order of increasing "de minimus" concentration limits.

Table 4-1

Quantities Assigned to Variables in the Evaluation of Postulated Leaching of Radionuclides from a Sanitary Landfill to a Watercourse

Variable	Quantity	Basis
Maximum dose commitment	1 mrem/yr to adults	"de minimus" dose rate limit
Water ingestion rate	440 liters/yr	1.2 liters/day
Fish ingestion rate	21 kg/yr	Reg. Guide 1.109, max. exposed adult
Shellfish ingestion rate	5 kg/yr	Reg. Guide 1.109, max. exposed adult
Surface Watercourse flow	3×10^{14} cc/yr	Assigned by authors
Fresh Water	Bioaccumulation factors	Reg. Guide 1.109
Transport time, waste to consumption	1 year	Assigned by authors
Fraction of tritium leached from waste	1.0 in a year	Assume tritium is soluble
Fraction of other isotopes leached from waste	0.01 per yr	Assigned by authors
Disposal rate	150 m^3/yr	Approximate production rate of spent powdered ion exchange resin/reactor
Duration of burial	10 years	Reasonable life of a sanitary landfill operation
Waste density	1.0 g/cm^3	Assigned density of bulk solid waste

TABLE 4-2

EXAMPLE OF COMPUTED CONCENTRATION LIMITS FOR ONE DISPOSAL MODE-PATHWAY-RECEPTOR CASE

CASE I-A -- SANITARY LANDFILL - LEACH INTO WATERCOURSE - TRANSIT TIME = 1 YEAR

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	4.5E+00		
C---14	5.73E+03 YRS	2.5E-01		
NA--24	1.50E+01 HRS	1.0E+07		
P---32	1.43E+01 DYS	1.0E+07		
CR--51	2.78E+01 DYS	1.0E+07		
MN--54	3.12E+02 DYS	9.1E-01		
MN--56	2.58E+00 HRS	1.0E+07		
FE--55	2.40E+00 YRS	6.0E-01		
FE--59	4.50E+01 DYS	4.3E+03		
CO--58	7.10E+01 DYS	6.0E+03		
CO--60	5.24E+00 YRS	3.5E+00		
NI--59	8.01E+04 YRS	4.0E+00		
NI--63	9.21E+01 YRS	1.6E+00		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	1.0E+07		
ZN--65	2.43E+02 DYS	9.2E-01		
ZN--69	5.50E+01 MIN	1.0E+07		
BR--83	2.40E+00 HRS	1.0E+07		
BR--84	3.20E+01 MIN	1.0E+07		
BR--85	3.00E+00 MIN	1.0E+07		
RB--86	1.87E+01 DYS	4.4E+06		
RB--88	1.80E+01 MIN	1.0E+07		
RB--89D	1.50E+01 MIN	1.0E+07	SR--89	100.
SR--89	5.06E+01 DYS	1.1E+04		
SR--90	2.88E+01 YRS	7.9E-03		
SR--91D	9.70E+00 HRS	1.0E+07	Y---91	100.
SR--92	2.70E+00 HRS	1.0E+07		
Y---90	2.67E+00 DYS	1.0E+07		
Y--91MD	5.00E+01 MIN	1.0E+07	Y---91	100.
Y---91	5.90E+01 DYS	2.8E+06		
Y---92	3.53E+00 HRS	1.0E+07		
Y---93D	1.02E+01 HRS	1.0E+07	NB-93M	100.
ZR--93D	1.50E+06 YRS	2.6E+01	NB-93M	100.
ZR--95D	6.50E+01 DYS	2.1E+04	NB--95	100.
ZR--97+D	1.70E+01 HRS	1.0E+07	NB--97	97.
NB-93M	3.70E+00 YRS	4.1E+01		
NB--95	3.50E+01 DYS	2.3E+06		
NB--97	1.20E+00 HRS	1.0E+07		
MO--99D	2.79E+00 DYS	1.0E+07	TC--99	100.
TC-99MD	6.00E+00 HRS	1.0E+07	TC--99	100.
TC--99	2.10E+05 YRS	5.1E+02		
RU-103	4.00E+01 DYS	4.1E+06		
RU-105D	4.43E+00 HRS	1.0E+07	RH-105	100.
RU-106	1.09E+00 YRS	3.7E+02		
RH-105	1.50E+00 DYS	1.0E+07		
AG110M	2.60E+02 DYS	1.3E+03		
TE125M	5.80E+01 DYS	4.8E+03		
TE127M+D	1.05E+02 DYS	1.6E+02	TE-127	3.
TE-127	9.30E+00 HRS	1.0E+07		
TE129M	3.40E+01 DYS	3.5E+04		

TABLE 4-2 (contd)

EXAMPLE OF COMPUTED CONCENTRATION LIMITS FOR
ONE DISPOSAL MODE-PATHWAY-RECEPTOR CASE
CASE I-A -- SANITARY LANDFILL -
LEACH INTO WATERCOURSE - TRANSIT TIME = 1 YEAR

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129D	1.12E+00 HRS	1.0E+07	I--129	100.
TE131MD	1.20E+00 DYS	1.0E+07	I--131	100.
TE-131D	2.50E+01 MIN	1.0E+07	I--131	100.
TE-132	3.25E+00 DYS	1.0E+07		
I--129	1.60E+07 YRS	2.8E+00		
I--130	1.24E+01 HRS	1.0E+07		
I--131	8.05E+00 DYS	1.0E+07		
I--132	2.30E+00 HRS	1.0E+07		
I--133	2.10E+01 HRS	1.0E+07		
I--134	5.30E+01 MIN	1.0E+07		
I--135D	6.70E+00 HRS	1.0E+07	CS-135	100.
CS-134	2.10E+00 YRS	1.8E-02		
CS-135	2.00E+06 YRS	5.8E-02		
CS-136	1.30E+01 DYS	1.0E+07		
CS-137	3.00E+01 YRS	7.5E-03		
CS-138	3.22E+01 MIN	1. E+07		
BA-140	1.28E+01 DYS	1.0E+07		
BA-141D	1.80E+01 MIN	1.0E+07	CE-141	100.
BA-142	1.10E+01 MIN	1.0E+07		
LA-140	1.67E+00 DYS	1.0E+07		
LA-141D	3.90E+00 HRS	1.0E+07	CE-141	100.
LA-142	1.40E+00 HRS	1.0E+07		
CE-141	3.25E+01 DYS	1.0E+07		
CE-143D	1.37E+00 DYS	1.0E+07	PR-143	100.
CE-144	2.85E+02 DYS	3.0E+03		
PR-143	1.37E+01 DYS	1.0E+07		
PR-144	1.73E+01 MIN	1.0E+07		
ND-147D	1.11E+01 DYS	3.7E+05	PM-147	100.
PM-147	2.60E+00 YRS	4.4E+03		
W--187	2.40E+01 HRS	1.0E+07		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	3.3E-05		
AC-227+D	2.16E+01 YRS	7.2E-03	RA-223	80.
TH-227D	1.82E+01 DYS	4.1E+05	RA-223	100.
PA-231+D	3.25E+04 YRS	2.6E-02	RA-223	59.
U--235	7.10E+08 YRS	5.3E-01		
NP-239D	2.35E+00 DYS	4.0E+06	PU-239	100.
PU-239	2.44E+04 YRS	1.0E+00		

BASED ON: LEACHING OF WASTE INTO WATERCOURSE
A MAXIMUM DOSE COMMITMENT OF 1.00 MREM/YR TO ADULTS
CONSUMPTION RATE OF WATER = 440.0 LITERS/YEAR
CONSUMPTION RATE OF FISH = 21.0 KG/YEAR
CONSUMPTION RATE OF SHELLFISH = 5.0 KG/YEAR
DILUTION FLOW RATE = 3.0E+14 CC/YEAR
FRESH WATER
TRANSPORT TIME FROM WASTE TO CONSUMPTION = 1.0E+00 YEARS
FRACTION OF TRITIUM LEACHED FROM WASTE = 1.0E+00 PER YEAR
FRACTION OF OTHER ISOTOPES LEACHED FROM WASTE 1.0E-02 PER YEA
BURIAL RATE = 1.5E+02 CUBIC METERS PER YEAR
DURATION OF BURIAL = 10.0 YEARS
WASTE DENSITY = 1.0 GM/CC

TABLE 4-3

MOST RESTRICTIVE CONCENTRATION LIMITS AND DISPOSAL-PATHWAY-RECEPTOR COMBINATIONS SELECTED FROM ALL COMPUTED CASES

CONCENTRATION LIMITS (UCI/GM)

NUCLIDE	DE MINIMUS LIMIT		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING	
	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN
H----3	61	3.E-05	62	4.E-05	63	6.E-05	29	7.E-05	30	9.E-05	129	1.E-04	131	2.E-04	130	1.E-04
C---14	129	4.E-06	130	4.E-06	131	4.E-06	132	4.E-06	133	4.E-06	112	5.E-06	113	5.E-06	114	6.E-06
NA--24	41	3.E-06	42	4.E-06	46	8.E-06	47	1.E-05	76	4.E-05	77	6.E-05	43	2.E-04	48	5.E-04
P---32	76	5.E-05	77	5.E-05	46	5.E-05	47	5.E-05	78	5.E-05	48	6.E-05	41	2.E-04	42	2.E-04
CR--51	76	1.E-04	77	1.E-04	78	1.E-04	46	2.E-04	47	2.E-04	48	2.E-04	41	2.E-04	42	2.E-04
MN--54	76	2.E-06	77	2.E-06	78	2.E-06	79	3.E-06	80	5.E-06	46	9.E-06	47	9.E-06	48	9.E-06
MN--56	41	6.E-06	42	6.E-05	46	1.E-04	76	5.E-04	47	1.E-03	77	5.E-03	125	4.E-01	124	4.E-02
FE--55	129	5.E-03	124	5.E-03	125	5.E-03	126	5.E-03	127	5.E-03	130	5.E-03	128	6.E-03	61	7.E-03
FE--59	76	3.E-06	77	3.E-06	78	3.E-06	79	5.E-06	46	6.E-06	47	7.E-06	48	7.E-06	41	9.E-06
CO--58	76	3.E-06	77	3.E-06	78	3.E-06	79	4.E-06	46	7.E-06	47	7.E-06	48	7.E-06	41	9.E-06
CO--60	76	8.E-07	77	8.E-07	78	8.E-07	79	8.E-07	80	9.E-07	52	9.E-07	81	3.E-06	53	2.E-06
NI--59	129	4.E-04	130	4.E-04	131	4.E-04	132	4.E-04	133	4.E-04	112	6.E-04	113	6.E-04	114	6.E-04
NI--63	129	3.E-05	130	3.E-05	131	3.E-05	112	5.E-05	113	5.E-05	132	6.E-05	114	1.E-04	61	3.E-04
NI--65	124	9.E-02	125	9.E-01	56	2.E+00	57	2.E+01	134	3.E+03	135	4.E+04	66	6.E+04	96	1.E+05
CU--64	41	4.E-05	42	6.E-05	46	2.E-04	47	2.E-04	76	8.E-04	77	1.E-03	43	4.E-03	48	2.E-02
ZN--65	76	4.E-06	77	4.E-06	78	4.E-06	79	4.E-06	61	6.E-06	129	9.E-06	36	1.E-05	62	1.E-05
ZN--69	41	7.E-04	46	6.E-03	76	3.E-02	42	5.E-01	47	5.E+00	124	8.E+00	77	2.E+01	56	4.E+01
BR--83	41	4.E-04	46	2.E-03	42	6.E-03	76	1.E-02	47	3.E-02	77	1.E-01	124	3.E+00	56	1.E+00
BR--84	41	5.E-06	46	4.E-04	76	2.E-03	42	4.E-01	56	1.E+00	124	3.E+00	47	3.E+01	77	2.E+02
BR--85	41	8.E-05	46	2.E-02	42	2.E-02	76	8.E-02	47	2.E-01	77	1.E+00	56	2.E+01	52	4.E+01
RB--86	76	2.E-05	77	2.E-05	78	2.E-05	46	3.E-05	47	3.E-05	48	3.E-05	41	7.E-05	42	7.E-05
RB--88	41	1.E-05	46	1.E-03	76	6.E-03	56	2.E+00	124	3.E+00	66	4.E+03	134	6.E+03	42	7.E+03
RB--89	41	5.E-06	46	8.E-04	76	4.E-03	77	8.E-02	78	8.E-02	79	1.E-01	47	2.E-01	48	2.E-01
SR--89	76	2.E-05	77	2.E-05	78	2.E-05	79	3.E-05	46	4.E-05	47	4.E-05	48	4.E-05	49	7.E-05
SR--90	129	8.E-07	130	8.E-07	131	9.E-07	61	1.E-06	62	1.E-06	63	1.E-06	112	2.E-06	113	2.E-06
SR--91	41	1.E-05	42	1.E-05	46	4.E-05	47	7.E-05	76	2.E-04	77	3.E-04	78	3.E-03	43	[illegible].E-03
SR--92	41	8.E-06	42	4.E-05	46	8.E-05	47	4.E-04	76	4.E-04	77	2.E-03	125	2.E-02	124	4.E-03
Y---90	46	3.E-05	47	4.E-05	48	9.E-05	41	1.E-04	42	1.E-04	76	1.E-04	77	1.E-04	43	3.E-04
Y--91M	41	1.E-05	46	8.E-04	76	4.E-03	42	2.E-02	77	3.E-02	78	3.E-02	79	5.E-02	47	8.E-02
Y---91	76	2.E-05	77	2.E-05	78	2.E-05	79	3.E-05	46	5.E-05	47	5.E-05	48	5.E-05	49	8.E-05
Y---92	41	2.E-05	42	1.E-04	46	2.E-04	76	9.E-04	47	1.E-03	77	5.E-03	125	6.E-02	124	1.E-02
Y---93	41	3.E-05	42	6.E-05	46	9.E-05	47	1.E-04	76	4.E-04	77	7.E-04	125	3.E-03	124	2.E-03
ZR--93	54	2.E-05	55	2.E-05	53	2.E-05	52	3.E-05	82	4.E-05	83	4.E-05	81	4.E-05	51	2.E-04
ZR--95	76	2.E-06	77	2.E-06	78	2.E-06	79	2.E-06	49	8.E-06	48	8.E-06	47	9.E-06	46	9.E-06
ZR--97	42	8.E-06	46	1.E-05	47	2.E-05	41	5.E-05	76	7.E-05	77	1.E-04	43	2.E-04	48	5.E-04
NB-93M	76	3.E-05	77	3.E-05	78	3.E-05	79	4.E-05	80	4.E-05	52	5.E-05	46	1.E-04	47	1.E-04
NB--95	76	4.E-06	77	5.E-06	78	5.E-06	46	9.E-06	47	9.E-06	79	9.E-06	48	1.E-05	41	1.E-05
NB--97	41	1.E-05	46	4.E-04	42	2.E-03	76	2.E-03	47	7.E-02	77	4.E-01	125	5.E+02	124	3.E+00
MO--99	46	3.E-05	47	4.E-05	42	5.E-05	41	6.E-05	48	8.E-05	43	9.E-05	77	1.E-04	76	1.E-04
TC-99M	41	9.E-05	42	2.E-04	46	8.E-04	47	2.E-03	76	4.E-03	77	1.E-02	125	[illegible]	[illegible]	[illegible]

TABLE 4-3 (contd)

CONCENTRATION LIMITS (UCI/GM)

NUCLIDE	DE MINIMUS LIMIT		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING	
	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN
AG110M	75	8.E-07	77	8.E-07	78	8.E-07	79	8.E-07	80	2.E-06	46	3.E-06	47	3.E-06	48	3.E-06
TE125M	129	5.E-05	130	4.E-04	61	5.E-04	76	7.E-04	77	7.E-04	78	8.E-04	79	1.E-03	46	2.E-03
TE127M	129	5.E-06	130	2.E-05	76	4.E-05	77	4.E-05	78	4.E-05	79	5.E-05	61	8.E-05	47	1.E-04
TE-127	46	3.E-04	41	1.E-03	47	2.E-03	42	2.E-03	76	5.E-03	124	8.E-03	125	2.E-02	77	9.E-03
TE129M	75	1.E-05	77	1.E-05	78	1.E-05	46	2.E-05	47	2.E-05	79	2.E-05	129	4.E-05	48	3.E-05
TE-129	41	6.E-05	46	2.E-03	76	8.E-03	42	2.E-02	47	4.E-01	124	1.E+00	77	2.E+00	56	7.E+00
TE131M	41	8.E-06	42	9.E-06	46	1.E-05	47	2.E-05	43	5.E-05	76	5.E-05	77	6.E-05	48	7.E-05
TE-131	41	2.E-05	46	2.E-03	76	6.E-03	47	9.E-03	42	1.E-02	48	1.E-02	77	1.E-02	43	1.E-02
TE-132	45	4.E-06	47	4.E-06	42	4.E-06	43	7.E-06	48	8.E-06	75	1.E-05	78	2.E-05	77	1.E-05
I--129	129	5.E-07	130	5.E-07	131	5.E-07	132	5.E-07	133	5.E-07	112	9.E-07	113	9.E-07	114	9.E-07
I--130	41	4.E-06	42	6.E-06	46	2.E-05	47	3.E-05	76	3.E-05	77	1.E-04	124	5.E-04	43	5.E-04
I--131	45	2.E-05	47	2.E-05	41	2.E-05	42	2.E-05	48	3.E-05	76	3.E-05	124	3.E-05	77	3.E-05
I--132	41	4.E-06	42	5.E-05	46	5.E-05	76	4.E-04	47	1.E-03	124	2.E-03	125	3.E-02	77	6.E-03
I--133	41	2.E-05	42	2.E-05	46	3.E-05	47	5.E-05	124	3.E-05	125	1.E-04	76	2.E-04	77	2.E-04
I--134	41	5.E-06	46	3.E-04	76	1.E-03	124	4.E-03	42	5.E-03	47	3.E-01	56	5.E-01	77	1.E+00
I--135	41	6.E-06	42	1.E-05	46	3.E-05	47	7.E-05	76	2.E-04	77	4.E-04	125	2.E-03	124	1.E-03
CS-134	75	1.E-06	77	1.E-06	78	1.E-06	79	1.E-06	80	1.E-06	52	3.E-06	46	4.E-06	47	4.E-06
CS-135	52	2.E-04	53	2.E-04	54	2.E-04	55	2.E-04	61	3.E-04	62	3.E-04	64	3.E-04	63	3.E-04
CS-136	46	4.E-05	47	4.E-06	76	4.E-06	77	4.E-06	48	5.E-06	41	5.E-06	78	5.E-06	42	5.E-06
CS-137	52	2.E-06	53	2.E-06	76	2.E-06	77	2.E-06	78	2.E-06	79	2.E-06	81	3.E-06	80	2.E-06
CS-138	41	5.E-06	46	4.E-04	76	2.E-03	42	4.E-01	56	9.E-01	124	1.E+00	47	3.E+01	77	2.E+02
BA-140	76	3.E-06	77	3.E-06	78	4.E-06	48	4.E-06	47	5.E-06	46	5.E-06	43	6.E-06	42	2.E-05
BA-141	41	2.E-05	46	1.E-03	42	4.E-03	76	7.E-03	47	2.E-02	77	5.E-02	78	1.E-01	48	3.E-01
BA-142	41	2.E-05	46	9.E-04	42	3.E-03	76	4.E-03	47	7.E-02	77	4.E-01	125	2.E+02	124	7.E+00
LA-140	41	5.E-06	42	6.E-06	46	7.E-06	47	8.E-06	43	2.E-05	76	3.E-05	77	3.E-05	48	3.E-05
LA-141	41	[illegible]	46	3.E-04	42	4.E-04	47	1.E-03	76	1.E-03	77	4.E-03	124	1.E-02	78	1.E-02
LA-142	41	5.E-06	46	2.E-04	42	4.E-04	76	7.E-04	47	1.E-02	77	6.E-02	125	3.E+01	124	4.E-01
CE-141	75	5.E-05	77	5.E-05	78	5.E-05	46	9.E-05	47	9.E-05	48	1.E-04	79	1.E-04	41	2.E-04
CE-143	46	3.E-05	41	3.E-05	47	3.E-05	42	3.E-05	76	4.E-05	77	4.E-05	78	5.E-05	48	5.E-05
CE-144	75	4.E-06	77	4.E-06	78	4.E-06	79	4.E-06	80	9.E-06	46	1.E-05	47	1.E-05	48	1.E-05
PR-143	76	5.E-06	46	5.E-06	77	5.E-06	47	5.E-06	78	6.E-06	48	6.E-06	41	1.E-05	42	1.E-05
PR-144	41	5.E-05	45	3.E-03	76	2.E-02	124	5.E+03	56	3.E+04	42	7.E+04	139	3.E+06	96	1.E+06
ND-147	46	4.E-05	47	4.E-05	76	4.E-05	77	4.E-05	48	5.E-05	78	5.E-05	41	6.E-05	42	6.E-05
PM-147	76	3.E-04	77	3.E-04	78	3.E-04	79	3.E-04	80	3.E-04	52	6.E-04	46	1.E-03	47	1.E-03
W--187	41	2.E-05	42	2.E-05	46	4.E-05	47	5.E-05	76	2.E-04	43	2.E-04	77	2.E-04	48	5.E-04
RA-223	124	3.E-05	125	7.E-05	126	4.E-05	56	5.E-05	57	5.E-05	58	6.E-05	127	3.E-04	59	5.E-04
RA-226	25	2.E-07	26	2.E-07	56	2.E-07	57	2.E-07	58	2.E-07	59	2.E-07	60	2.E-07	27	2.E-07
AC-227	129	1.E-05	130	1.E-05	131	1.E-05	112	2.E-05	128	2.E-05	108	2.E-05	113	3.E-05	109	3.E-05
TH-227	127	8.E-05	126	1.E-04	59	1.E-04	125	[illegible]	58	3.E-04	124	3.E-04	129	1.E-02	57	2.E-03
PA-231	132	4.E-06	133	4.E-06	131	6.E-06	130	7.E-06	129	7.E-06	114	8.E-06	115	8.E-06	113	1.E-05
U--235	129	5.E-05	130	5.E-05	131	5.E-05	132	5.E-05	133	5.E-05	112	1.E-04	113	1.E-04	114	1.E-04
NP-239	124	6.E-03	125	7.E-03	126	2.E-02	127	2.E+02	104	2.E+02	105	2.E+02	106	2.E+02	107	2.E+02

TABLE 4-3 (contd)

CONCENTRATION LIMITS (UCI/GM)

TABLE 25 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 5 YEARS
TABLE 26 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 10 YEARS
TABLE 27 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 100 YEARS
TABLE 29 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 5 YEARS
TABLE 30 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 10 YEARS
TABLE 41 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER NO DECAY
TABLE 42 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.001 YEARS
TABLE 43 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.01 YEARS
TABLE 46 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0 DECAY
TABLE 47 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER .001 YR
TABLE 48 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0.01 YR
TABLE 49 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0.1 YRS
TABLE 51 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 10 YRS
TABLE 52 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 5 YRS
TABLE 53 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 10 YR
TABLE 54 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 100 Y
TABLE 55 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 1E3 Y
TABLE 56 - CASE II-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER NO DECAY
TABLE 57 - CASE II-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.001 YEARS DECAY
TABLE 58 - CASE II-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.01 YEARS DECAY
TABLE 59 - CASE II-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.1 YEARS DECAY
TABLE 60 - CASE II-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE 1 YEAR DECAY
TABLE 61 - CASE II-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 0.5 YEARS DECAY
TABLE 62 - CASE II-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 1 YEAR DECAY
TABLE 63 - CASE II-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 10 YEARS DECAY
TABLE 64 - CASE II-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 100 YEARS DECAY
TABLE 66 - CASE II-G -- FILL WANTED DISPOSAL - EROSION INTO WATECOURSE AFTER NO DECAY
TABLE 76 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER NO DECAY
TABLE 77 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 0.001 YRS
TABLE 78 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 0.01 YEARS
TABLE 79 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 0.1 YEARS
TABLE 80 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 1 YEAR
TABLE 81 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 10 YEARS
TABLE 82 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 100 YEARS
TABLE 83 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 1000 YEARS
TABLE 86 - CASE III-C -- SANITARY LANDFILL - INHALATION SPILLED WASTE AFTER NO DECAY
TABLE 104 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 5 YRS
TABLE 105 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 10 YRS
TABLE 106 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 100 YR
TABLE 107 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 1000 Y
TABLE 108 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 5 YEARS
TABLE 109 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 10 YEARS
TABLE 112 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 5 YEARS
TABLE 113 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 10 YEARS
TABLE 114 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 100 YEARS
TABLE 115 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 1000 YEARS
TABLE 124 - CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER NO DECAY
TABLE 125 - CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.001 YEARS DECAY
TABLE 126 - CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.01 YEARS DECAY
TABLE 127 - CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.1 YEARS DECAY
TABLE 128 - CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 1 YEAR DEACY
TABLE 129 - CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 0.5 YEARS DECAY
TABLE 130 - CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 1 YEAR DECAY
TABLE 131 - CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 10 YEARS DECAY
TABLE 132 - CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 100 YEARS DECAY
TABLE 133 - CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 1000 YEARS DECAY
TABLE 134 - CASE IV-G -- FILL WANTED DISPOSAL - EROSION INTO WATERCOURSE AFTER NO DECAY
TABLE 135 - CASE IV-G -- FILL WANTED DISPOSAL - EROSION INTO WATERCOURSE AFTER 0.001 YEARS
TABLE 139 - CASE IV-H -- FILL WANTED DISPOSAL - INHALATION OF WASTE ERODED AFTER NO DECAY

TABLE 4-4

MOST RESTRICTIVE CONCENTRATION LIMITS AND DISPOSAL-PATHWAY-RECEPTOR COMBINATIONS SELECTED FROM ALL COMPUTED CASES ARRANGED BY INCREASING "DE MINIMUS" CONCENTRATION LIMIT

CONCENTRATION LIMITS (UCI/GM)

NUCLIDE	DE MINIMUS LIMIT		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING	
	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN
RA-226	25	2.E-07	26	2.E-07	56	2.E-07	57	2.E-07	58	2.E-07	59	2.E-07	60	2.E-07	27	2.E-07
I--129	129	5.E-07	130	5.E-07	131	5.E-07	132	5.E-07	133	5.E-07	112	9.E-07	113	9.E-07	114	9.E-07
SR--90	129	8.E-07	130	8.E-07	131	9.E-07	61	1.E-06	62	1.E-06	63	1.E-06	112	2.E-06	113	2.E-06
AG110M	76	8.E-07	77	8.E-07	78	8.E-07	79	8.E-07	80	2.E-06	46	3.E-06	47	3.E-06	48	3.E-06
CO--60	76	8.E-07	77	8.E-07	78	8.E-07	79	8.E-07	80	9.E-07	52	9.E-07	81	3.E-06	53	2.E-06
CS-134	76	1.E-06	77	1.E-06	78	1.E-06	79	1.E-06	80	1.E-06	52	3.E-06	46	4.E-06	47	4.E-06
CS-137	52	2.E-06	53	2.E-06	76	2.E-06	77	2.E-06	78	2.E-06	79	2.E-06	81	3.E-06	80	2.E-06
ZR--95	76	2.E-06	77	2.E-06	78	2.E-06	79	2.E-06	49	3.E-06	48	8.E-06	47	9.E-06	46	9.E-06
MN--54	76	2.E-06	77	2.E-06	78	2.E-06	79	3.E-06	80	5.E-06	46	9.E-06	47	9.E-06	48	9.E-06
RU-106	76	2.E-06	77	2.E-06	78	2.E-06	79	3.E-06	80	5.E-06	129	6.E-06	46	9.E-06	47	9.E-06
CO--58	76	3.E-06	77	3.E-06	78	3.E-06	79	4.E-06	46	7.E-06	47	7.E-06	48	7.E-06	41	9.E-06
FE--59	76	3.E-06	77	3.E-06	78	3.E-06	79	5.E-06	46	6.E-06	47	7.E-06	48	7.E-06	41	9.E-06
NA--24	41	3.E-06	42	4.E-06	46	8.E-06	47	1.E-05	76	4.E-05	77	6.E-05	43	2.E-04	48	5.E-04
BA-140	76	3.E-06	77	3.E-06	78	4.E-06	48	4.E-06	47	5.E-06	46	5.E-06	43	6.E-06	42	2.E-05
ZN--65	76	4.E-06	77	4.E-06	78	4.E-06	79	4.E-06	61	6.E-06	129	9.E-06	86	1.E-05	62	1.E-05
CE-144	76	4.E-06	77	4.E-06	78	4.E-06	79	4.E-06	80	9.E-06	46	1.E-05	47	1.E-05	48	1.E-05
C---14	129	4.E-06	130	4.E-06	131	4.E-06	132	4.E-06	133	4.E-06	112	5.E-06	113	5.E-06	114	6.E-06
TE-132	46	4.E-06	47	4.E-06	42	4.E-06	43	7.E-06	48	8.E-06	76	1.E-05	78	2.E-05	77	1.E-05
I--132	41	4.E-06	42	5.E-05	46	8.E-05	76	4.E-04	47	1.E-03	124	2.E-03	125	3.E-02	77	6.E-03
CS-136	46	4.E-06	47	4.E-06	76	4.E-06	77	4.E-06	48	5.E-06	41	5.E-06	78	5.E-06	42	5.E-06
I--130	41	4.E-06	42	6.E-06	46	2.E-05	47	3.E-05	76	8.E-05	77	1.E-04	124	5.E-04	43	5.E-04
PA-231	132	4.E-06	133	4.E-06	131	6.E-06	130	7.E-06	129	7.E-06	114	8.E-06	115	8.E-06	113	1.E-05
NB--95	76	4.E-06	77	5.E-06	78	5.E-06	46	9.E-06	47	9.E-06	79	9.E-06	48	1.E-05	41	1.E-05
RB--89	41	5.E-06	46	8.E-04	76	4.E-03	77	8.E-02	78	8.E-02	79	1.E-01	47	2.E-01	48	2.E-01
CS-138	41	5.E-06	46	4.E-04	76	2.E-03	42	4.E-01	56	9.E-01	124	1.E+00	47	3.E+01	77	2.E+02
PR-143	76	5.E-06	46	5.E-06	77	5.E-06	47	5.E-06	78	5.E-06	48	6.E-06	41	1.E-05	42	1.E-05
BR--84	41	5.E-06	46	4.E-04	76	2.E-03	42	4.E-01	56	1.E+00	124	3.E+00	47	3.E+01	77	2.E+02
I--134	41	5.E-06	46	3.E-04	76	1.E-03	124	4.E-03	42	5.E-03	47	3.E-01	56	5.E-01	77	1.E+00
LA-140	41	5.E-06	42	6.E-06	46	7.E-06	47	8.E-06	43	2.E-05	76	3.E-05	77	3.E-05	48	3.E-05
LA-142	41	5.E-06	46	2.E-04	42	4.E-04	76	7.E-04	47	1.E-02	77	6.E-02	125	3.E+01	124	4.E-01
TE127M	129	5.E-06	130	2.E-05	76	4.E-05	77	4.E-05	78	4.E-05	79	5.E-05	61	8.E-05	47	1.E-04
RU-103	76	6.E-06	77	6.E-06	78	6.E-06	79	1.E-05	46	1.E-05	47	1.E-05	48	1.E-05	41	2.E-05
MN--56	41	6.E-06	42	6.E-05	46	1.E-04	76	5.E-04	47	1.E-03	77	5.E-03	125	4.E-01	124	4.E-02
I--135	41	6.E-06	42	1.E-05	46	3.E-05	47	7.E-05	76	2.E-04	77	4.E-04	125	2.E-03	124	1.E-03
ZR--97	42	8.E-06	46	1.E-05	47	2.E-05	41	5.E-05	76	7.E-05	77	1.E-04	43	2.E-04	48	5.E-04
SR--92	41	8.E-06	42	4.E-05	46	8.E-05	47	4.E-04	76	4.E-04	77	2.E-03	125	2.E-02	124	4.E-03
TE131M	41	8.E-06	42	9.E-06	46	1.E-05	47	2.E-05	43	5.E-05	76	5.E-05	77	6.E-05	48	7.E-05
AC-227	129	1.E-05	130	1.E-05	131	1.E-05	112	2.E-05	128	2.E-05	118	2.E-05	113	3.E-05	109	3.E-05
RB--88	41	1.E-05	46	1.E-03	76	6.E-03	56	2.E+00	124	3.E+00	66	4.E+03	134	6.E+03	42	7.E+03
TE129M	76	1.E-05	77	1.E-05	78	1.E-05	46	2.E-05	47	2.E-05	79	2.E-05	129	4.E-05	48	3.E-05
NB--97	41	1.E-05	46	4.E-04	42	2.E-03	76	2.E-03	47	7.E-02	77	4.E-01	125	5.E+02	124	3.E+00
RU-105	41	1.E-05	42	4.E-05	46	1.E-04	47	3.E-04	76	5.E-04	77	2.E-03	43	3.E-03	48	5.E-03
SR--91	41	1.E-05	42	1.E-05	46	4.E-05	47	7.E-05	76	2.E-04	77	3.E-04	78	3.E-03	43	4.E-03
Y--91M	41	1.E-05	46	8.E-04	76	4.E-03	42	2.E-02	77	3.E-02	78	3.E-02	79	5.E-02	47	8.E-02
I--133	41	2.E-05	42	2.E-05	46	3.E-05	47	5.E-05	124	8.E-05	125	1.E-04	76	2.E-04	77	2.E-04

TABLE 4-4 (contd)

CONCENTRATION LIMITS (UCI/GM)

NUCLIDE	DE MINIMUS LIMIT		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING	
	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN
SR--89	76	2.E-05	77	2.E-05	78	2.E-05	79	3.E-05	46	4.E-05	47	4.E-05	48	4.E-05	49	7.E-05
BA-142	41	2.E-05	46	9.E-04	42	3.E-03	76	4.E-03	47	7.E-02	77	4.E-01	125	2.E+02	124	7.E+06
TC--99	129	2.E-05	130	2.E-05	131	2.E-05	132	2.E-05	133	2.E-05	112	3.E-05	113	3.E-05	114	3.E-05
I--131	46	2.E-05	47	2.E-05	41	2.E-05	42	2.E-05	48	3.E-05	76	3.E-05	124	3.E-05	77	3.E-05
BA-141	41	2.E-05	46	1.E-03	42	4.E-03	76	7.E-03	47	2.E-02	77	5.E-02	78	1.E-01	48	3.E-01
RB--86	76	2.E-05	77	2.E-05	78	2.E-05	46	3.E-05	47	3.E-05	48	3.E-05	41	7.E-05	42	7.E-05
Y---91	76	2.E-05	77	2.E-05	78	2.E-05	79	3.E-05	46	5.E-05	47	5.E-05	48	5.E-05	49	8.E-05
W--187	41	2.E-05	42	2.E-05	46	4.E-05	47	5.E-05	76	2.E-04	43	2.E-04	77	2.E-04	48	5.E-04
ZR--93	54	2.E-05	55	2.E-05	53	2.E-05	52	3.E-05	82	4.E-05	83	4.E-05	81	4.E-05	51	2.E-04
TM-171	41	2.E-05	46	2.E-03	76	6.E-03	47	9.E-03	42	1.E-02	48	1.E-02	77	1.E-02	43	1.E-02
Y---92	41	2.E-05	42	1.E-04	46	2.E-04	76	9.E-04	47	1.E-03	77	5.E-03	125	6.E-02	124	1.E-02
CE-143	46	2.E-05	41	3.E-05	47	3.E-05	42	3.E-05	76	4.E-05	77	4.E-05	78	5.E-05	48	5.E-05
NI--63	129	3.E-05	130	3.E-05	131	3.E-05	112	5.E-05	113	5.E-05	132	6.E-05	114	1.E-04	61	3.E-04
RA-223	124	3.E-05	125	3.E-05	126	4.E-05	56	5.E-05	57	5.E-05	58	6.E-05	127	3.E-04	59	5.E-04
MO--99	46	3.E-05	47	4.E-05	42	5.E-05	41	6.E-05	48	9.E-05	43	9.E-05	77	1.E-04	76	1.E-04
H----3	61	3.E-05	62	4.E-05	63	6.E-05	29	7.E-05	30	9.E-05	129	1.E-04	131	2.E-04	130	1.E-04
Y---90	45	3.E-05	47	4.E-05	48	9.E-05	41	1.E-04	42	1.E-04	76	1.E-04	77	1.E-04	43	3.E-04
Y---93	41	3.E-05	42	6.E-05	46	8.E-05	47	1.E-04	76	4.E-04	77	7.E-04	125	3.E-03	124	2.E-03
NP-234	76	3.E-05	77	3.E-05	78	3.E-05	79	4.E-05	80	4.E-05	52	5.E-05	46	1.E-04	47	1.E-04
ND-147	46	4.E-05	47	4.E-05	76	4.E-05	77	4.E-05	48	5.E-05	78	5.E-05	41	6.E-05	42	6.E-05
CU--64	41	4.E-05	42	6.E-05	46	2.E-04	47	2.E-04	76	8.E-04	77	1.E-03	43	4.E-03	48	2.E-02
P---32	76	5.E-05	77	5.E-05	46	5.E-05	47	5.E-05	78	5.E-05	48	6.E-05	41	2.E-04	42	2.E-04
CE-141	76	5.E-05	77	5.E-05	78	5.E-05	46	9.E-05	47	9.E-05	48	1.E-04	79	1.E-04	41	2.E-04
TE125M	129	5.E-05	130	4.E-04	61	5.E-04	76	7.E-04	77	7.E-04	78	8.E-04	79	1.E-03	46	2.E-03
U--235	129	5.E-05	130	5.E-05	131	5.E-05	132	5.E-05	133	5.E-05	112	1.E-04	113	1.E-04	114	1.E-04
PU-239	124	5.E-05	105	5.E-05	106	5.E-05	107	5.E-05	108	1.E-04	109	1.E-04	125	1.E-04	124	1.E-04
PR-144	41	3.E-05	46	3.E-03	76	2.E-02	124	5.E+03	56	3.E+04	42	7.E+04	139	3.E+06	96	1.E+06
TE-129	41	6.E-05	46	2.E-03	76	8.E-03	42	2.E-02	47	4.E-01	124	1.E+00	77	2.E+00	56	7.E+00
LA-141	41	7.E-05	46	3.E-04	42	4.E-04	47	1.E-03	76	1.E-03	77	4.E-03	124	1.E-02	78	1.E-02
TH-227	127	8.E-05	126	1.E-04	59	1.E-04	125	2.E-04	58	3.E-04	124	3.E-04	129	1.E-02	57	2.E-03
KR--85	41	8.E-05	46	2.E-02	42	2.E-02	76	8.E-02	47	2.E-01	77	1.E+00	56	2.E+01	52	4.E+01
TC-99M	41	9.E-05	42	2.E-04	46	8.E-04	47	2.E-03	76	4.E+03	77	1.E-02	125	1.E+00	124	4.E-01
RH-105	41	9.E-05	42	1.E-04	46	1.E-04	47	1.E-04	43	5.E-04	76	5.E-04	77	6.E-04	48	6.E-04
CR--51	76	1.E-04	77	1.E-04	78	1.E-04	46	2.E-04	47	2.E-04	48	2.E-04	41	2.E-04	42	2.E-04
CS-135	52	2.E-04	53	2.E-04	54	2.E-04	55	2.E-04	61	3.E-04	62	3.E-04	64	3.E-04	63	3.E-04
PM-147	76	3.E-04	77	3.E-04	78	3.E-04	79	3.E-04	80	3.E-04	52	6.E-04	46	1.E-03	47	1.E-03
NI--59	129	4.E-04	130	4.E-04	131	4.E-04	132	4.E-04	133	4.E-04	112	6.E-04	113	6.E-04	114	6.E-04
RB--83	41	4.E-04	46	2.E-03	42	6.E-03	76	1.E-02	47	3.E-02	77	1.E-01	124	3.E+00	56	1.E+00
ZN--69	41	7.E-04	46	6.E-03	76	3.E-02	42	5.E-01	47	5.E+00	124	8.E+00	77	2.E+01	56	4.E+01
TE-127	46	9.E-04	41	1.E-03	47	2.E-03	42	2.E-03	76	5.E-03	124	8.E-03	125	2.E-02	77	9.E-03
FE--55	129	5.E-03	124	5.E-03	125	5.E-03	126	5.E-03	127	5.E-03	130	5.E-03	128	6.E-03	61	7.E-03
NP-239	124	6.E-03	125	7.E-03	126	2.E-02	127	2.E+02	104	2.E+02	105	2.E+02	106	2.E+02	107	2.E+02
NI--65	124	9.E-02	125	9.E-01	56	2.E+00	57	2.E+01	134	3.E+03	135	4.E+04	66	6.E+04	96	1.E+05

TABLE 4-4 (contd)

CONCENTRATION LIMITS (UCI/GM)

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TABLE  25 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 5 YEARS
TABLE  26 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 10 YEARS
TABLE  27 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 100 YEARS
TABLE  29 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 5 YEARS
TABLE  30 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 10 YEARS
TABLE  41 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER NO DECAY
TABLE  42 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.001 YEARS
TABLE  43 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.01 YEARS
TABLE  46 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0 DECAY
TABLE  47 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER .001 YR
TABLE  48 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0.01 YR
TABLE  49 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0.1 YRS
TABLE  51 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 10 YRS
TABLE  52 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 5 YRS
TABLE  53 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 10 YR
TABLE  54 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 100 Y
TABLE  55 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 1E3 Y
TABLE  56 - CASE II-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER NO DECAY
TABLE  57 - CASE II-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.001 YEARS DECAY
TABLE  58 - CASE II-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.01 YEARS DECAY
TABLE  59 - CASE II-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.1 YEARS DECAY
TABLE  60 - CASE II-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE 1 YEAR DECAY
TABLE  61 - CASE II-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 0.5 YEARS DECAY
TABLE  62 - CASE II-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 1 YEAR DECAY
TABLE  63 - CASE II-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 10 YEARS DECAY
TABLE  64 - CASE II-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 100 YEARS DECAY
TABLE  66 - CASE II-G -- FILL WANTED DISPOSAL - EROSION INTO WATERCOURSE AFTER NO DECAY
TABLE  76 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER NO DECAY
TABLE  77 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 0.001 YRS
TABLE  78 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 0.01 YEARS
TABLE  79 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 0.1 YEARS
TABLE  80 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 1 YEAR
TABLE  81 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 10 YEARS
TABLE  82 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 100 YEARS
TABLE  83 - CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 1000 YEARS
TABLE  96 - CASE III-C -- SANITARY LANDFILL - INHALATION SPILLED WASTE AFTER NO DECAY
TABLE 104 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 5 YRS
TABLE 105 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 10 YRS
TABLE 106 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 100 YR
TABLE 107 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 1000 Y
TABLE 108 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 5 YEARS
TABLE 109 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 10 YEARS
TABLE 112 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 5 YEARS
TABLE 113 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 10 YEARS
TABLE 114 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 100 YEARS
TABLE 115 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 1000 YEARS
TABLE 124 - CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER NO DECAY
TABLE 125 - CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.001 YEARS DECAY
TABLE 126 - CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.01 YEARS DECAY
TABLE 127 - CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.1 YEARS DECAY
TABLE 128 - CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 1 YEAR DEACY
TABLE 129 - CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 0.5 YEARS DECAY
TABLE 130 - CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 1 YEAR DECAY
TABLE 131 - CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 10 YEARS DECAY
TABLE 132 - CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 100 YEARS DECAY
TABLE 133 - CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 1000 YEARS DECAY
TABLE 134 - CASE IV-G -- FILL WANTED DISPOSAL - EROSION INTO WATERCOURSE AFTER NO DECAY
TABLE 135 - CASE IV-G -- FILL WANTED DISPOSAL - EROSION INTO WATERCOURSE AFTER 0.001 YEARS
TABLE 139 - CASE IV-H -- FILL WANTED DISPOSAL - INHALATION OF WASTE ERODED AFTER NO DECAY
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TABLE 4-5

MOST RESTRICTIVE ACTIVITY CONCENTRATION LIMITS FOR
SOLID WASTE DISPOSAL IN A SANITARY LANDFILL
CONCENTRATION LIMITS (UCI/GM)

NUCLIDE	DE MINIMUS LIMIT		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING	
	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN
H----3	29	7.E-05	30	9.E-05	112	2.E-04	113	3.E-04	31	1.E-02	114	4.E-02	25	3.E-01	26	4.E-01
C---14	112	5.E-06	113	5.E-06	114	6.E-06	115	6.E-06	29	9.E-06	30	9.E-06	31	9.E-06	32	1.E-05
NA--24	41	3.E-06	42	4.E-06	46	8.E-06	47	1.E-05	43	2.E-04	48	5.E-04	5	3.E+04	13	3.E+04
P---32	46	5.E-05	47	5.E-05	48	6.E-05	41	2.E-04	42	2.E-04	43	2.E-04	49	3.E-04	44	1.E-03
CR--51	46	2.E-04	47	2.E-04	48	2.E-04	41	2.E-04	42	2.E-04	43	2.E-04	49	5.E-04	44	5.E-03
MN--54	46	9.E-06	47	9.E-06	48	9.E-06	49	1.E-05	41	1.E-05	42	1.E-05	43	1.E-05	44	1.E-05
MN--56	41	6.E-06	42	6.E-05	46	1.E-04	47	1.E-03	89	4.E+02	89	4.E+03	96	6.E+04	5	2.E+04
FE--55	108	2.E-02	25	3.E-02	112	3.E-02	29	5.E-02	109	8.E-02	26	1.E-01	113	1.E-01	36	2.E-01
FE--59	46	6.E-06	47	7.E-06	48	7.E-06	41	9.E-06	42	9.E-06	43	1.E-05	49	1.E-05	44	2.E-05
CO--58	46	7.E-06	47	7.E-06	48	7.E-06	41	9.E-06	42	9.E-06	43	1.E-05	49	1.E-05	44	1.E-05
CO--60	52	9.E-07	53	2.E-06	46	3.E-06	47	3.E-06	48	3.E-06	49	3.E-06	50	4.E-06	41	5.E-06
NI--59	112	6.E-04	113	6.E-04	114	6.E-04	115	6.E-04	29	1.E-03	30	1.E-03	31	1.E-03	32	1.E-03
NI--63	112	5.E-05	113	5.E-05	114	1.E-04	29	5.E-04	30	5.E-04	31	1.E-03	108	1.E-03	109	1.E-03
NI--65	96	1.E+05	88	1.E+05	97	1.E+06	89	1.E+06	5	2.E+06	1	1.E+07	2	1.E+07	3	1.E+07
CU--64	41	4.E-05	42	6.E-05	46	2.E-04	47	2.E-04	43	4.E-03	48	2.E-02	96	3.E+04	89	4.E+04
ZN--65	46	1.E-05	47	1.E-05	48	1.E-05	49	1.E-05	41	2.E-05	42	2.E-05	43	2.E-05	44	2.E-05
ZN--69	41	7.E-04	46	6.E-03	42	5.E-01	47	5.E+00	88	3.E+05	96	1.E+06	5	2.E+06	1	1.E+07
BR--83	41	4.E-04	46	2.E-03	42	6.E-03	47	3.E-02	5	5.E+05	88	4.E+06	96	5.E+06	13	2.E+06
BR--84	41	5.E-06	46	4.E-04	42	4.E-01	47	3.E+01	5	4.E+05	88	1.E+06	96	4.E+06	13	1.E+06
BR--85	41	8.E-05	46	2.E-02	42	2.E-02	47	2.E-01	52	4.E+01	53	6.E+01	48	2.E+02	49	2.E+02
RB--86	46	3.E-05	47	3.E-05	48	3.E-05	41	7.E-05	46	7.E-05	43	8.E-05	49	1.E-04	44	3.E-04
RB--88	41	1.E-05	46	1.E-03	42	7.E+03	5	1.E+05	88	2.E+05	47	7.E+05	96	3.E+06	13	2.E+06
RB--89	41	5.E-06	46	8.E-04	47	2.E-01	48	2.E-01	49	3.E-01	42	1.E+00	43	1.E+00	44	2.E+00
SR--89	46	4.E-05	47	4.E-05	48	4.E-05	49	7.E-05	41	2.E-04	42	2.E-04	43	2.E-04	44	4.E-04
SR--90	112	2.E-06	113	2.E-06	29	2.E-05	30	3.E-06	52	3.E-06	53	4.E-06	108	1.E-05	109	1.E-05
SR--91	41	1.E-05	42	1.E-05	46	4.E-05	47	7.E-05	43	4.E-03	48	9.E-03	49	1.E-02	44	7.E-02
SR--92	41	8.E-06	42	4.E-05	46	8.E-05	47	4.E-04	43	2.E+02	48	2.E+03	89	2.E+04	88	9.E+03
Y---90	45	3.E-05	47	4.E-05	48	9.E-05	41	1.E-04	42	1.E-04	43	3.E-04	49	4.E-01	44	1.E+00
Y--91M	41	1.E-05	46	8.E-04	42	2.E-02	47	8.E-02	48	9.E-02	49	1.E-01	43	5.E-01	44	8.E-01
Y---91	46	5.E-05	47	5.E-05	48	5.E-05	49	8.E-05	41	3.E-04	42	3.E-04	43	3.E-04	44	5.E-04
Y---92	41	2.E-05	42	1.E-04	46	2.E-04	47	1.E-03	43	7.E+02	48	5.E+03	96	2.E+04	89	4.E+04
Y---93	41	3.E-05	42	6.E-05	46	8.E-05	47	1.E-04	43	1.E-02	48	3.E-02	89	2.E+03	88	1.E+03
ZR--93	54	2.E-05	55	2.E-05	53	2.E-05	52	3.E-05	51	2.E-04	50	8.E-04	115	3.E-03	114	3.E-03
ZR--95	49	8.E-06	48	8.E-06	47	9.E-06	46	9.E-06	44	1.E-05	41	1.E-05	42	1.E-05	43	1.E-05
ZR--97	42	4.E-06	46	1.E-05	47	2.E-05	41	5.E-05	43	2.E-04	48	5.E-04	97	3.E+03	96	2.E+03
NB-93M	52	5.E-05	46	1.E-04	47	1.E-04	48	1.E-04	53	1.E-04	49	1.E-04	50	2.E-04	51	9.E-04
NB--95	46	9.E-06	47	9.E-06	48	1.E-05	41	1.E-05	42	1.E-05	43	1.E-05	49	2.E-05	44	2.E-05
NB--97	41	1.E-05	46	4.E-04	42	2.E-03	47	7.E-02	88	2.E+04	96	5.E+05	89	3.E+06	1	1.E+07
MO--99	46	3.E-05	47	4.E-05	42	5.E-05	41	6.E-05	48	8.E-05	43	9.E-05	49	3.E-01	44	3.E-01
TC-99M	41	9.E-05	42	2.E-04	46	8.E-04	47	2.E-03	43	2.E+00	48	2.E+01	113	8.E+03	112	8.E+03
TC--99	112	3.E-05	113	3.E-05	114	3.E-05	115	3.E-05	52	8.E-05	53	8.E-05	54	9.E-05	55	8.E-05
RU-103	46	1.E-05	47	1.E-05	48	1.E-05	41	2.E-05	42	2.E-05	43	2.E-05	49	2.E-05	44	3.E-05
RU-105	41	1.E-05	42	4.E-05	46	1.E-04	47	3.E-04	43	3.E-03	48	5.E-03	49	2.E+04	44	1.E+04
RU-106	46	9.E-06	47	9.E-06	48	9.E-06	49	1.E-05	50	2.E-05	42	2.E-05	43	2.E-05	44	2.E-05
RH-105	41	9.E-05	42	1.E-04	46	1.E-04	47	1.E-04	43	5.E-04	48	6.E-04	49	3.E+03	44	2.E+03

TABLE 4-5 (contd)

CONCENTRATION LIMITS (UCI/GM)

NUCLIDE	DE MINIMUS LIMIT		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING	
	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN
AG110M	46	3.E-06	47	3.E-06	48	3.E-06	49	3.E-06	41	4.E-06	42	4.E-06	43	4.E-06	44	4.E-06
TE125M	46	2.E-03	47	2.E-03	48	2.E-03	49	3.E-03	41	2.E-02	42	2.E-02	43	2.E-02	44	4.E-02
TE127M	47	1.E-04	48	1.E-04	46	1.E-04	49	2.E-04	43	1.E-03	44	1.E-03	50	1.E-03	42	2.E-03
TE-127	46	9.E-04	41	1.E-03	47	2.E-03	42	2.E-03	48	6.E-01	43	7.E-01	89	3.E+03	88	2.E+03
TE129M	46	2.E-05	47	2.E-05	48	3.E-05	42	5.E-05	49	5.E-05	43	5.E-05	44	1.E-04	41	2.E-04
TE-129	41	6.E-05	46	2.E-03	42	2.E-02	47	4.E-01	112	1.E+05	113	1.E+05	115	1.E+05	114	1.E+05
TE131M	41	8.E-06	42	9.E-06	46	1.E-05	47	2.E-05	43	5.E-05	48	7.E-05	49	2.E-03	44	3.E-03
TE-131	41	2.E-05	46	2.E-03	47	9.E-03	42	1.E-02	48	1.E-02	43	1.E-02	49	2.E-01	44	2.E-01
TE-132	46	4.E-06	47	4.E-06	42	4.E-06	43	7.E-06	48	8.E-06	41	4.E-05	49	9.E-03	44	8.E-03
I--129	112	9.E-07	113	9.E-07	114	9.E-07	115	9.E-07	108	5.E-06	109	5.E-06	110	5.E-06	111	5.E-06
I--130	41	4.E-06	42	6.E-06	46	2.E-05	47	3.E-05	43	5.E-04	48	2.E-03	97	1.E+03	96	7.E+02
I--131	46	2.E-05	47	2.E-05	41	2.E-05	42	2.E-05	48	3.E-05	43	3.E-05	49	4.E-04	44	5.E-04
I--132	41	4.E-06	42	5.E-05	46	8.E-05	47	1.E-03	96	3.E+03	88	1.E+04	97	4.E+04	89	2.E+05
I--133	41	2.E-05	42	2.E-05	46	3.E-05	47	5.E-05	43	3.E-04	48	5.E-04	49	2.E-01	44	5.E-01
I--134	41	5.E-06	46	3.E-04	42	5.E-03	47	3.E-01	96	5.E+03	88	2.E+04	13	7.E+05	5	3.E+06
I--135	41	6.E-06	42	1.E-05	46	3.E-05	47	7.E-05	43	8.E-03	48	4.E-02	97	3.E+03	96	1.E+03
CS-134	52	3.E-06	46	4.E-06	47	4.E-06	48	4.E-06	49	4.E-06	41	5.E-06	42	5.E-06	50	5.E-06
CS-135	52	2.E-04	53	2.E-04	54	2.E-04	55	2.E-04	29	4.E-04	30	4.E-04	31	4.E-04	32	4.E-04
CS-136	46	4.E-06	47	4.E-06	48	5.E-06	41	5.E-06	42	5.E-06	43	6.E-06	49	3.E-05	44	3.E-05
CS-137	52	2.E-06	53	2.E-06	46	9.E-06	47	9.E-06	48	9.E-06	49	9.E-06	50	9.E-06	51	1.E-05
CS-138	41	5.E-06	46	4.E-04	42	4.E-01	47	3.E+01	5	9.E+04	88	1.E+05	96	2.E+06	13	1.E+06
BA-140	48	4.E-06	47	5.E-06	46	5.E-06	43	6.E-06	42	2.E-05	49	2.E-05	44	3.E-05	41	3.E-05
BA-141	41	2.E-05	46	1.E-03	42	4.E-03	47	2.E-02	48	3.E-01	43	4.E-01	49	5.E-01	44	9.E-01
BA-142	41	2.E-05	46	9.E-04	42	3.E-03	47	7.E-02	96	1.E+06	1	1.E+07	2	1.E+07	3	1.E+07
LA-140	41	5.E-06	42	6.E-06	46	7.E-06	47	8.E-06	43	2.E-05	48	3.E-05	49	2.E+01	44	2.E+01
LA-141	41	7.E-05	46	3.E-04	42	4.E-04	47	1.E-03	48	2.E-02	43	3.E-02	49	4.E-02	44	7.E-02
LA-142	41	5.E-06	46	2.E-04	42	4.E-04	47	1.E-02	96	2.E+05	48	2.E+05	1	1.E+07	2	1.E+07
CE-141	46	9.E-05	47	9.E-05	48	1.E-04	41	2.E-04	42	2.E-04	43	2.E-04	49	2.E-04	44	3.E-04
CE-143	46	3.E-05	41	3.E-05	47	3.E-05	42	3.E-05	48	5.E-05	43	9.E-05	49	3.E-04	44	7.E-04
CE-144	46	1.E-05	47	1.E-05	48	1.E-05	49	1.E-05	50	3.E-05	42	5.E-05	43	5.E-05	44	5.E-05
PR-143	46	5.E-06	47	5.E-06	48	6.E-06	41	1.E-05	42	1.E-05	43	2.E-05	49	3.E-05	44	8.E-05
PR-144	41	5.E-05	46	3.E-03	42	7.E+04	96	1.E+06	47	5.E+06	1	1.E+07	2	1.E+07	3	1.E+07
ND-147	46	4.E-05	47	4.E-05	48	5.E-05	41	6.E-05	42	6.E-05	43	7.E-05	49	4.E-04	44	6.E-04
PM-147	52	6.E-04	46	1.E-03	47	1.E-03	48	1.E-03	49	1.E-03	50	1.E-03	53	2.E-03	51	1.E-02
W--187	41	2.E-05	42	2.E-05	46	4.E-05	47	5.E-05	43	2.E-04	48	5.E-04	89	1.E+03	88	8.E+02
RA-223	96	6.E+00	97	6.E+00	98	7.E+00	88	4.E+01	89	5.E+01	99	5.E+01	90	6.E+01	5	7.E+01
RA-226	25	2.E-07	26	2.E-07	27	2.E-07	28	4.E-07	108	5.E-07	109	5.E-07	29	5.E-07	30	5.E-07
AC-227	112	2.E-05	108	2.E-05	113	3.E-05	109	3.E-05	25	5.E-05	26	6.E-05	104	8.E-05	29	8.E-05
TH-227	96	4.E+00	97	4.E+00	98	4.E+00	99	8.E+00	91	1.E+02	90	1.E+02	8	2.E+02	89	3.E+02
PA-231	114	8.E-06	115	8.E-06	113	1.E-05	110	1.E-05	111	1.E-05	112	1.E-05	106	2.E-05	107	2.E-05
U--235	112	1.E-04	113	1.E-04	114	1.E-04	115	1.E-04	108	2.E-04	109	2.E-04	110	2.E-04	111	2.E-04
NP-239	104	2.E+02	105	2.E+02	106	2.E+02	107	2.E+02	108	4.E+02	109	4.E+02	111	4.E+02	110	4.E+02
PU-239	104	5.E-05	105	5.E-05	106	5.E-05	107	5.E-05	108	1.E-04	109	1.E-04	111	1.E-04	110	1.E-04

TABLE 4-5 (contd)

CONCENTRATION LIMITS (UCI/GM)

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TABLE   1 - CASE I-A -- SANITARY LANDFILL - LEACH INTO WATERCOURSE - TRANSIT TIME = 1 YEAR
TABLE   2 - CASE I-A -- SANITARY LANDFILL - LEACH INTO WATERCOURSE - TRANSIT TIME = 10 YRS
TABLE   3 - CASE I-A -- SANITARY LANDFILL - LEACH INTO WATERCOURSE - TRANSIT TIME = 100 YRS
TABLE   5 - CASE I-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - NO DECAY
TABLE   8 - CASE I-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - 0.1 YEARS DECAY
TABLE  13 - CASE I-C -- SANITARY LANDFILL - INHALATION OF SPILLED WASTE AFTER NO DECAY
TABLE  25 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 5 YEARS
TABLE  26 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 10 YEARS
TABLE  27 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 100 YEARS
TABLE  28 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 1000 YEARS
TABLE  29 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 5 YEARS
TABLE  30 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 10 YEARS
TABLE  31 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 100 YEARS
TABLE  32 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 1000. YEARS
TABLE  41 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER NO DECAY
TABLE  42 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.001 YEARS
TABLE  43 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.01 YEARS
TABLE  44 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.1 YEARS
TABLE  46 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0 DECAY
TABLE  47 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER .001 YR
TABLE  48 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0.01 YR
TABLE  49 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0.1 YRS
TABLE  50 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 1 YEAR
TABLE  51 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 10 YRS
TABLE  52 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 5 YRS
TABLE  53 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 10 YR
TABLE  54 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 100 Y
TABLE  55 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 1E3 Y
TABLE  88 - CASE III-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - NO DECAY
TABLE  89 - CASE III-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - 0.001 YEARS DECAY
TABLE  90 - CASE III-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - 0.01 YEARS DECAY
TABLE  91 - CASE III-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - 0.1 YEARS DECAY
TABLE  96 - CASE III-C -- SANITARY LANDFILL - INHALATION SPILLED WASTE AFTER NO DECAY
TABLE  97 - CASE III-C -- SANITARY LANDFILL - INHALATION SPILLED WASTE AFTER 0.001 YEARS
TABLE  98 - CASE III-C -- SANITARY LANDFILL - INHALATION SPILLED WASTE AFTER 0.01 YEARS
TABLE  99 - CASE III-C -- SANITARY LANDFILL - INHALATION SPILLED WASTE AFTER 0.1 YEARS DECAY
TABLE 104 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 5 YRS
TABLE 105 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 10 YRS
TABLE 106 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 100 YR
TABLE 107 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 1000 Y
TABLE 108 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 5 YEARS
TABLE 109 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 10 YEARS
TABLE 110 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 100 YEARS
TABLE 111 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 1000 YEARS
TABLE 112 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 5 YEARS
TABLE 113 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 10 YEARS
TABLE 114 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 100 YEARS
TABLE 115 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 1000 YEARS
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TABLE 4-6

MOST RESTRICTIVE ACTIVITY CONCENTRATION LIMITS FOR
SOLID WASTE DISPOSAL IN A SANITARY LANDFILL
ARRANGED BY INCREASING "DE MINIMUS" CONCENTRATION LIMIT

CONCENTRATION LIMITS (UCI/GM)

NUCLIDE	DE MINIMUS LIMIT		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING	
	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN
RA-226	25	2.E-07	26	2.E-07	27	2.E-07	28	4.E-07	108	5.E-07	109	5.E-07	29	5.E-07	30	5.E-07
I--129	112	9.E-07	113	9.E-07	114	9.E-07	115	9.E-07	108	5.E-06	109	5.E-06	110	5.E-06	111	5.E-06
CO--60	52	9.E-07	53	2.E-06	46	3.E-06	47	3.E-06	48	3.E-06	49	3.E-06	50	4.E-06	41	5.E-06
CS-137	52	2.E-06	53	2.E-06	46	9.E-06	47	9.E-06	48	9.E-06	49	9.E-06	50	9.E-06	51	1.E-05
SR--90	112	2.E-06	113	2.E-06	29	2.E-06	30	3.E-06	52	3.E-06	53	4.E-06	108	1.E-05	109	1.E-05
AG110M	46	3.E-06	47	3.E-06	48	3.E-06	49	3.E-06	41	4.E-06	42	4.E-06	43	4.E-06	44	4.E-06
NA--24	41	3.E-06	42	4.E-06	46	8.E-06	47	1.E-05	43	2.E-04	48	5.E-04	5	3.E+04	13	3.E+04
CS-134	52	3.E-06	46	4.E-06	47	4.E-06	48	4.E-06	49	4.E-06	41	5.E-06	42	5.E-06	50	5.E-06
TE-132	46	4.E-06	47	4.E-06	42	4.E-05	43	7.E-06	48	8.E-06	41	4.E-05	49	9.E-03	44	8.E-03
I--132	41	4.E-06	42	5.E-05	46	8.E-05	47	1.E-03	96	3.E+03	88	1.E+04	97	4.E+04	89	2.E+05
CS-136	46	4.E-06	47	4.E-06	48	5.E-06	41	5.E-06	42	5.E-06	43	6.E-06	49	3.E-05	44	3.E-05
BA-140	48	4.E-06	47	5.E-06	46	5.E-06	43	6.E-06	42	2.E-05	49	2.E-05	44	3.E-05	41	3.E-05
I--131	41	4.E-06	42	6.E-06	46	2.E-05	47	3.E-05	43	5.E-04	48	2.E-03	97	1.E+03	96	7.E+02
SR--89	41	5.E-06	46	3.E-04	47	2.E-01	48	2.E-01	49	3.E-01	42	1.E+00	43	1.E+00	44	2.E+00
CS-138	41	5.E-06	46	4.E-04	42	4.E-01	47	3.E+01	5	9.E+04	88	1.E+05	96	2.E+06	13	1.E+06
PR-143	46	5.E-06	47	5.E-06	48	6.E-06	41	1.E-05	42	1.E-05	43	2.E-05	49	3.E-05	44	8.E-05
RB--86	41	5.E-06	46	4.E-04	42	4.E-01	47	3.E+01	5	4.E+05	88	1.E+06	96	4.E+06	13	1.E+06
I--134	41	5.E-06	46	3.E-04	42	5.E-03	47	3.E-01	96	5.E+03	88	2.E+04	13	7.E+05	5	3.E+06
LA-140	41	5.E-06	42	6.E-06	46	7.E-06	47	8.E-06	43	2.E-05	48	3.E-05	49	2.E+01	44	2.E+01
LA-142	41	5.E-06	46	2.E-04	42	4.E-04	47	1.E-02	96	2.E+05	88	2.E+05	1	1.E+07	2	1.E+07
C---14	112	5.E-06	113	5.E-06	114	6.E-06	115	6.E-06	29	9.E-06	30	9.E-06	31	9.E-06	32	1.E-05
MN--56	41	6.E-06	42	6.E-05	46	1.E-04	47	1.E-03	88	4.E+02	89	4.E+03	96	6.E+04	5	2.E+04
I--135	41	6.E-06	42	1.E-05	46	3.E-05	47	7.E-05	43	8.E-03	48	4.E-02	97	3.E+03	96	1.E+03
FE--59	46	6.E-06	47	7.E-06	48	7.E-06	41	9.E-06	42	9.E-06	43	1.E-05	49	1.E-05	44	2.E-05
CO--58	46	7.E-06	47	7.E-06	48	7.E-06	41	9.E-06	42	9.E-06	43	1.E-05	49	1.E-05	44	1.E-05
ZR--97	42	8.E-06	46	1.E-05	47	2.E-05	41	5.E-05	43	2.E-04	48	5.E-04	97	3.E+03	96	2.E+03
SR--92	41	8.E-06	42	4.E-05	46	8.E-05	47	4.E-04	43	2.E+02	48	2.E+03	89	2.E+04	88	9.E+03
ZR--95	49	8.E-06	48	8.E-06	47	9.E-06	46	9.E-06	44	1.E-05	41	1.E-05	42	1.E-05	43	1.E-05
TE131M	41	8.E-06	42	9.E-06	46	1.E-05	47	2.E-05	43	5.E-05	48	7.E-05	49	2.E-03	44	3.E-03
PA-231	114	8.E-06	115	8.E-06	113	1.E-05	110	1.E-05	111	1.E-05	112	1.E-05	106	2.E-05	107	2.E-05
MN--54	46	9.E-06	47	9.E-06	48	9.E-06	49	1.E-05	41	1.E-05	42	1.E-05	43	1.E-05	44	1.E-05
RU-106	46	9.E-06	47	9.E-06	48	9.E-06	49	1.E-05	50	2.E-05	42	2.E-05	43	2.E-05	44	2.E-05
NB--95	46	9.E-06	47	9.E-06	48	1.E-05	41	1.E-05	42	1.E-05	43	1.E-05	49	2.E-05	44	2.E-05
RB--88	41	1.E-05	46	1.E-03	42	7.E+03	5	1.E+05	88	2.E+05	47	7.E+05	96	3.E+06	13	2.E+06
ZN--65	45	1.E-05	47	1.E-05	48	1.E-05	49	1.E-05	41	2.E-05	42	2.E-05	43	2.E-05	44	2.E-05
NB--97	41	1.E-05	46	4.E-04	42	2.E-03	47	7.E-02	88	2.E+04	96	5.E+05	89	3.E+06	1	1.E+07
RU-103	46	1.E-05	47	1.E-05	48	1.E-05	41	2.E-05	42	2.E-05	43	2.E-05	49	2.E-05	44	3.E-05
RU-105	41	1.E-05	42	4.E-05	46	1.E-04	47	3.E-04	43	3.E-03	48	5.E-03	49	2.E+04	44	1.E+04
SR--91	41	1.E-05	42	1.E-05	46	4.E-05	47	7.E-05	43	4.E-03	48	5.E-03	49	1.E-02	44	7.E-02
Y--91M	41	1.E-05	46	8.E-04	42	2.E-02	47	8.E-02	48	9.E-02	49	1.E-01	43	5.E-01	44	8.E-01
CE-144	46	1.E-05	47	1.E-05	48	1.E-05	49	1.E-05	50	3.E-05	42	5.E-05	43	5.E-05	44	5.E-05
I--133	41	2.E-05	42	4.E-05	46	3.E-05	47	5.E-05	43	3.E-04	48	5.E-04	49	2.E-01	44	5.E-01
BA-142	41	2.E-05	46	9.E-04	42	3.E-03	47	7.E-02	96	1.E+06	1	1.E+07	2	1.E+07	3	1.E+07
I--131	46	2.E-05	47	2.E-05	41	2.E-05	42	2.E-05	48	3.E-05	43	3.E-05	49	4.E-04	44	5.E-04
ND-141	41	2.E-05	46	1.E-03	42	4.E-03	47	2.E-02	48	3.E-01	43	4.E-01	49	5.E-01	44	9.E-01

TABLE 4-6 (contd)

CONCENTRATION LIMITS (UCI/GM)

NUCLIDE	DE MINIMUS LIMIT		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING		LIMITING	
	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN	TABLE	CONCEN
W--187	41	2.E-05	42	2.E-05	46	4.E-05	47	5.E-05	43	2.E-04	48	5.E-04	89	1.E+03	88	8.E+02
ZR--93	54	2.E-05	55	2.E-05	53	2.E-05	52	3.E-05	51	2.E-04	50	8.E-04	115	3.E-03	114	3.E-03
AC-227	112	2.E-05	108	2.E-05	113	3.E-05	109	3.E-05	25	5.E-05	26	6.E-05	104	8.E-05	29	8.E-05
TE-131	41	2.E-05	46	2.E-03	47	9.E-03	42	1.E-02	48	1.E-02	43	1.E-02	49	2.E-01	44	2.E-01
Y---92	41	2.E-05	42	1.E-04	46	2.E-04	47	1.E-03	43	7.E+02	48	5.E+03	96	2.E+04	89	4.E+04
TE129M	46	2.E-05	47	2.E-05	48	3.E-05	42	5.E-05	49	5.E-05	43	5.E-05	44	1.E-04	41	2.E-04
RB--86	46	3.E-05	47	3.E-05	48	3.E-05	41	7.E-05	42	7.E-05	43	8.E-05	49	1.E-04	44	3.E-04
TC--99	112	3.E-05	113	3.E-05	114	3.E-05	115	3.E-05	52	8.E-05	53	8.E-05	54	8.E-05	55	8.E-05
CE-143	46	3.E-05	41	3.E-05	47	3.E-05	42	3.E-05	48	5.E-05	43	9.E-05	49	3.E-04	44	7.E-04
MO--99	46	3.E-05	47	4.E-05	42	5.E-05	41	6.E-05	48	8.E-05	43	9.E-05	49	3.E-01	44	3.E-01
Y---90	46	3.E-05	47	4.E-05	48	9.E-05	41	1.E-04	42	1.E-04	43	3.E-04	49	4.E-01	44	1.E+00
Y---93	41	3.E-05	42	6.E-05	46	8.E-05	47	1.E-04	43	1.E-02	48	3.E-02	89	2.E+03	88	1.E+03
ND-147	46	4.E-05	47	4.E-05	48	5.E-05	41	6.E-05	42	6.E-05	43	7.E-05	49	4.E-04	44	6.E-04
CU--64	41	4.E-05	42	6.E-05	46	2.E-04	47	2.E-04	43	4.E-03	48	2.E-02	96	3.E+04	89	4.E+04
SR--89	46	4.E-05	47	4.E-05	48	4.E-05	49	7.E-05	41	2.E-04	42	2.E-04	43	2.E-04	44	4.E-04
P---32	46	5.E-05	47	5.E-05	48	6.E-05	41	2.E-04	42	2.E-04	43	2.E-04	49	3.E-04	44	1.E-03
NI--63	112	5.E-05	113	5.E-05	114	1.E-04	29	5.E-04	30	5.E-04	31	1.E-03	108	1.E-03	109	1.E-03
PU-239	104	5.E-05	105	5.E-05	106	5.E-05	107	5.E-05	108	1.E-04	109	1.E-04	111	1.E-04	110	1.E-04
Y---91	46	5.E-05	47	5.E-05	48	5.E-05	49	8.E-05	41	3.E-04	42	3.E-04	43	3.E-04	44	5.E-04
CE-144	41	5.E-05	46	3.E-03	42	7.E+04	96	1.E+06	47	5.E+06	1	1.E+07	2	1.E+07	3	1.E+07
NB-93M	52	5.E-05	46	1.E-04	47	1.E-04	48	1.E-04	53	1.E-04	49	1.E-04	50	2.E-04	51	9.E-04
TE-129	41	6.E-05	46	2.E-03	42	2.E-02	47	4.E-01	112	1.E+05	113	1.E+05	115	1.E+05	114	1.E+05
H----3	29	7.E-05	30	9.E-05	112	2.E-04	113	3.E-04	31	1.E-02	114	4.E-02	25	3.E-01	26	4.E-01
LA-141	41	7.E-05	46	3.E-04	42	4.E-04	47	1.E-03	48	2.E-02	43	3.E-02	49	4.E-02	44	7.E-02
SR--85	41	8.E-05	46	2.E-02	42	2.E-02	47	2.E-01	52	4.E+01	53	6.E+01	48	2.E+02	49	2.E+02
TC-99M	41	9.E-05	42	2.E-04	46	8.E-04	47	2.E-03	43	2.E+00	48	2.E+01	113	8.E+03	112	8.E+03
RH-105	41	9.E-05	42	1.E-04	46	1.E-04	47	1.E-04	43	5.E-04	48	6.E-04	49	3.E+03	44	2.E+03
CE-141	46	9.E-05	47	9.E-05	48	1.E-04	41	2.E-04	42	2.E-04	43	2.E-04	49	2.E-04	44	3.E-04
U--235	112	1.E-04	113	1.E-04	114	1.E-04	115	1.E-04	108	2.E-04	109	2.E-04	110	2.E-04	111	2.E-04
TE127M	47	1.E-04	48	1.E-04	46	1.E-04	49	2.E-04	43	1.E-03	44	1.E-03	50	1.E-03	42	2.E-03
CS-135	52	2.E-04	53	2.E-04	54	2.E-04	55	2.E-04	29	4.E-04	30	4.E-04	31	4.E-04	32	4.E-04
CR--51	46	2.E-04	47	2.E-04	48	2.E-04	41	2.E-04	42	2.E-04	43	2.E-04	49	5.E-04	44	5.E-04
SR--83	41	4.E-04	46	2.E-03	42	6.E-03	47	3.E-02	5	5.E+05	88	1.E+06	96	5.E+06	13	2.E+06
PM-147	52	6.E-04	46	1.E-03	47	1.E-03	48	1.E-03	49	1.E-03	50	1.E-03	53	2.E-03	51	1.E-02
NI--59	112	6.E-04	113	6.E-04	114	6.E-04	115	6.E-04	29	1.E-03	30	1.E-03	31	1.E-03	32	1.E-03
ZN--69	41	7.E-04	46	6.E-03	42	5.E-01	47	5.E+00	88	3.E+05	96	1.E+06	5	2.E+06	1	1.E+07
TE-127	46	9.E-04	41	1.E-03	47	2.E-03	42	2.E-03	48	6.E-01	43	7.E-01	89	3.E+03	88	2.E+03
TE125M	46	2.E-03	47	2.E-03	48	2.E-03	49	3.E-03	41	2.E-02	42	2.E-02	43	2.E-02	44	4.E-02
FE--55	108	2.E-02	25	3.E-02	112	3.E-02	29	5.E-02	109	9.E-02	26	1.E-01	113	1.E-01	30	2.E-01
TH-227	96	4.E+[illegible]	97	4.E+00	98	4.E+00	99	8.E+00	91	1.E+02	90	1.E+02	8	2.E+02	89	3.E+02
RA-223	96	6.E+00	97	6.E+00	99	7.E+00	88	4.E+01	89	5.E+01	99	5.E+01	90	6.E+01	5	7.E+01
NP-239	104	2.E+02	105	2.E+02	106	2.E+02	107	2.E+02	108	4.E+02	109	4.E+02	111	4.E+02	110	4.E+02
NI--65	96	1.E+05	88	1.E+05	97	1.E+06	89	1.E+06	5	2.E+06	1	1.E+07	2	1.E+07	3	1.E+07

TABLE 4-6 (contd)

CONCENTRATION LIMITS (UCI/GM)

TABLE 1 - CASE I-A -- SANITARY LANDFILL - LEACH INTO WATERCOURSE - TRANSIT TIME = 1 YEAR
TABLE 2 - CASE I-A -- SANITARY LANDFILL - LEACH INTO WATERCOURSE - TRANSIT TIME = 10 YRS
TABLE 3 - CASE I-A -- SANITARY LANDFILL - LEACH INTO WATERCOURSE - TRANSIT TIME = 100 YRS
TABLE 5 - CASE I-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - NO DECAY
TABLE 8 - CASE I-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - 0.1 YEARS DECAY
TABLE 13 - CASE I-C -- SANITARY LANDFILL - INHALATION OF SPILLED WASTE AFTER NO DECAY
TABLE 25 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 5 YEARS
TABLE 26 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 10 YEARS
TABLE 27 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 100 YEARS
TABLE 28 - CASE I-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 1000 YEARS
TABLE 29 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 5 YEARS
TABLE 30 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 10 YEARS
TABLE 31 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 100 YEARS
TABLE 32 - CASE I-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 1000. YEARS
TABLE 41 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER NO DECAY
TABLE 42 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.001 YEARS
TABLE 43 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.01 YEARS
TABLE 44 - CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.1 YEARS
TABLE 46 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0 DECAY
TABLE 47 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER .001 YR
TABLE 48 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0.01 YR
TABLE 49 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0.1 YRS
TABLE 50 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 1 YEAR
TABLE 51 - CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 10 YRS
TABLE 52 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 5 YRS
TABLE 53 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 10 YR
TABLE 54 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 100 Y
TABLE 55 - CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 1E3 Y
TABLE 88 - CASE III-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - NO DECAY
TABLE 89 - CASE III-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - 0.001 YEARS DECAY
TABLE 90 - CASE III-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - 0.01 YEARS DECAY
TABLE 91 - CASE III-B -- SANITARY LANDFILL - SPILLAGE INTO WATERCOURSE - 0.1 YEARS DECAY
TABLE 96 - CASE III-C -- SANITARY LANDFILL - INHALATION SPILLED WASTE AFTER NO DECAY
TABLE 97 - CASE III-C -- SANITARY LANDFILL - INHALATION SPILLED WASTE AFTER 0.001 YEARS
TABLE 98 - CASE III-C -- SANITARY LANDFILL - INHALATION SPILLED WASTE AFTER 0.01 YEARS
TABLE 99 - CASE III-C -- SANITARY LANDFILL - INHALATION SPILLED WASTE AFTER 0.1 YEARS DECAY
TABLE 104 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 5 YRS
TABLE 105 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 10 YRS
TABLE 106 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 100 YR
TABLE 107 - CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 1000 Y
TABLE 108 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 5 YEARS
TABLE 109 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 10 YEARS
TABLE 110 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 100 YEARS
TABLE 111 - CASE III-E -- SANITARY LANDFILL - CHILD EATS DIRT ON WASTE SITE AFTER 1000 YEARS
TABLE 112 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 5 YEARS
TABLE 113 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 10 YEARS
TABLE 114 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 100 YEARS
TABLE 115 - CASE III-F -- SANITARY LANDFILL - FOOD GROWN ON WASTE SITE AFTER 1000 YEARS

5.0 COST-BENEFIT CONSIDERATIONS

Conceptually, cost-benefit analysis can be applied to disposal of solid wastes with a "de minimus" radioactivity concentration by weighting costs and benefits of alternate means of disposal. In lieu of any other guidance, the interim value of \$1,000 per total body man-rem from Appendix I is used herein. In practice, the limited distribution of discarded bulk solid wastes and the critical pathways for exposure of man limit the number of people potentially exposed to those who live on the disposal site or who eat food grown thereon. Therefore, large population doses will not result from disposal of material with "de minimus" concentrations of radioactivity.

Assuming the cost of unrestricted disposal of "de minimus" solid waste is zero, the cost of shallow-land burial of low-level radioactive waste is $\$6/ft^3$, and the population dose associated with shallow-land burial is zero, then a practical cost-benefit criterion for unrestricted disposal of solid waste is that any waste having an associated population dose potential of less than 6 man-millirem per cubic foot of waste discarded in an unrestricted manner is "de minimus."

As an illustration that the individual dose rate criterion is more limiting than the cost-benefit criterion, consider the example of the disposal of 150 m^3 of spent, powdered resin, approximately the volume generated annually at a large light-water reactor power station. If unrestricted disposal causes more than 6 man-mrem/ft^3, or about 30 man-rem for disposal of the total volume of the waste, then the alternate, shallow-land burial, would be indicated by ALARA considerations. Since the "de minimus" health protection criterion limits the individual dose

rate to 1 mrem total body dose per year, about 600 persons, each receiving 1 mrem/year for 50 years would be required to reach the limit associated with the cost benefit criterion, 30 man-rem, for disposal of the 150 m^3 of waste. Since all of the limiting pathways require that the exposed individual reside directly on the disposal sites or eat food grown thereon, it is hardly reasonable to expect the population exposure to reach the limit of the cost-benefit criterion. Hence, the "de minimus" limit based on individual dose will result in a lower limit than one based on ALARA considerations.

With such a low individual total body dose rate of one millirem per year or less, any cost-benefit interpretation based on an estimate of population integrated dose equivalent is probably unrealistic. The NCRP and ICRP cautions in regard to the inappropriateness of quantitative risk-benefit balancing at such a low dose rate is thus persuasive against the use of such an analysis for decisionmaking in connection with "de minimus" waste disposal (NC75a, IC73).

6.0 APPLICATION OF THE GENERIC METHOD

The aim of this study has been to develop a method for determining "de minimus" concentrations in homogeneous, bulk solid wastes so that they may be disposed of in the manner of ordinary domestic solid wastes without any special requirements because of the low radioactivity content. The methodology developed has been applied to land disposal of spent, powdered resin from PWR secondary systems as an example. Neither initial dispersion by air or water, i.e., incineration or sea dumping, were considered; however, the methodology developed can be applied to other materials by considering the nature of the source, feasible disposal scenarios, and environmental pathways to man.

6.1 Application to Secondary Resins

As an example of the application of the method, the expected concentration of each radionuclide adsorbed on spent, powdered resin from PWR secondary systems has been computed using the PWR GALE code (NRC76) to calculate primary coolant concentrations and the SECONDARY code (by Nuclear Safety Associates) to calculate activity concentrations of the spent resins. The "de minimus" concentrations calculated in Section 4 apply, of course, to this type of waste. By comparing the expected concentrations to the "de minimus" concentration limits, it is possible to rank the isotopes in order of significance. The sum of the ratios of expected to "de minimus" concentrations of all radionuclides in the waste must not exceed unity if the waste itself is to be "de minimus." This method is also summarized in Figure 6-1.

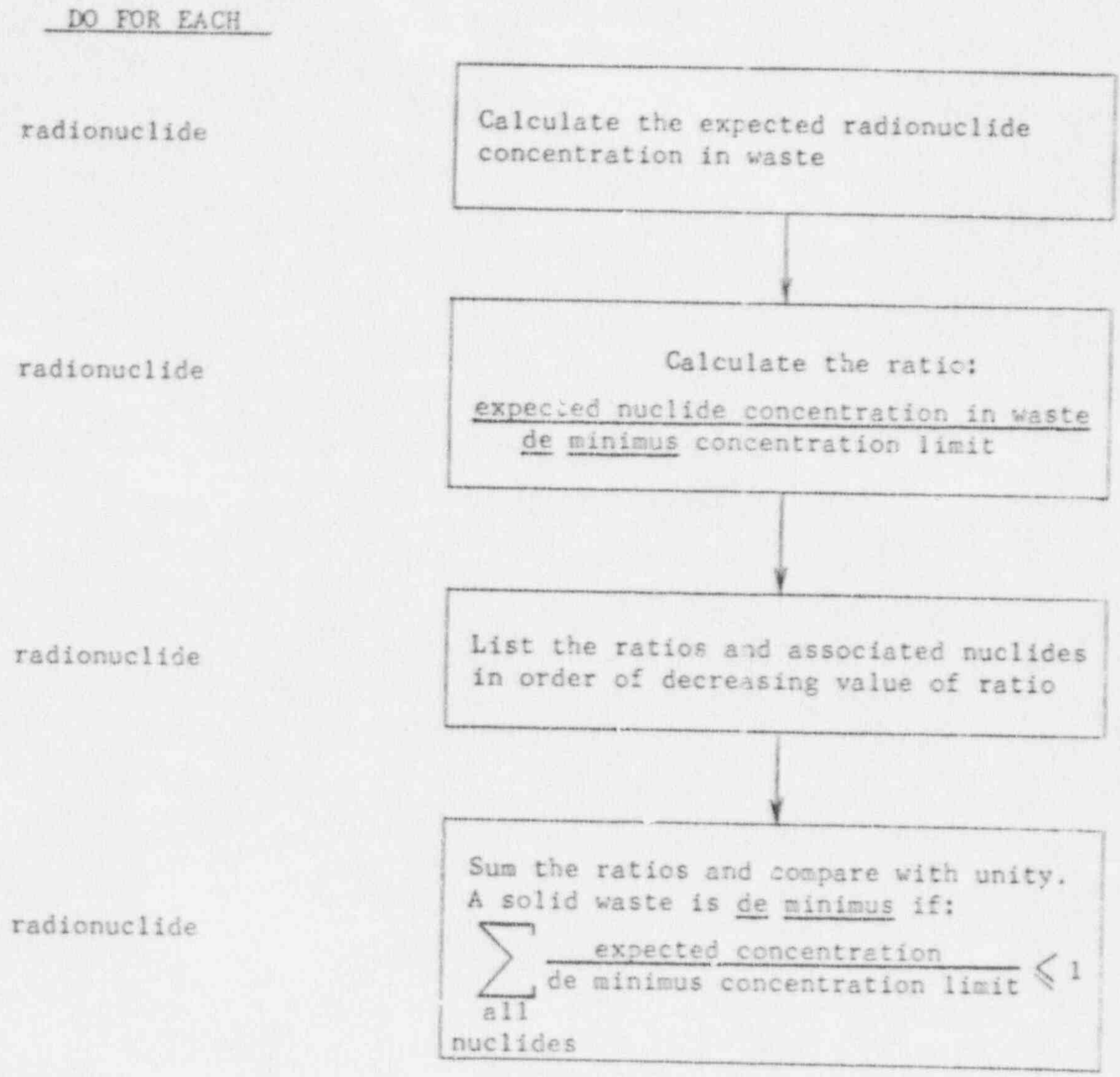

Figure 6-1 Summary Diagram of Method of Calculating Whether Waste Is "de minimus'

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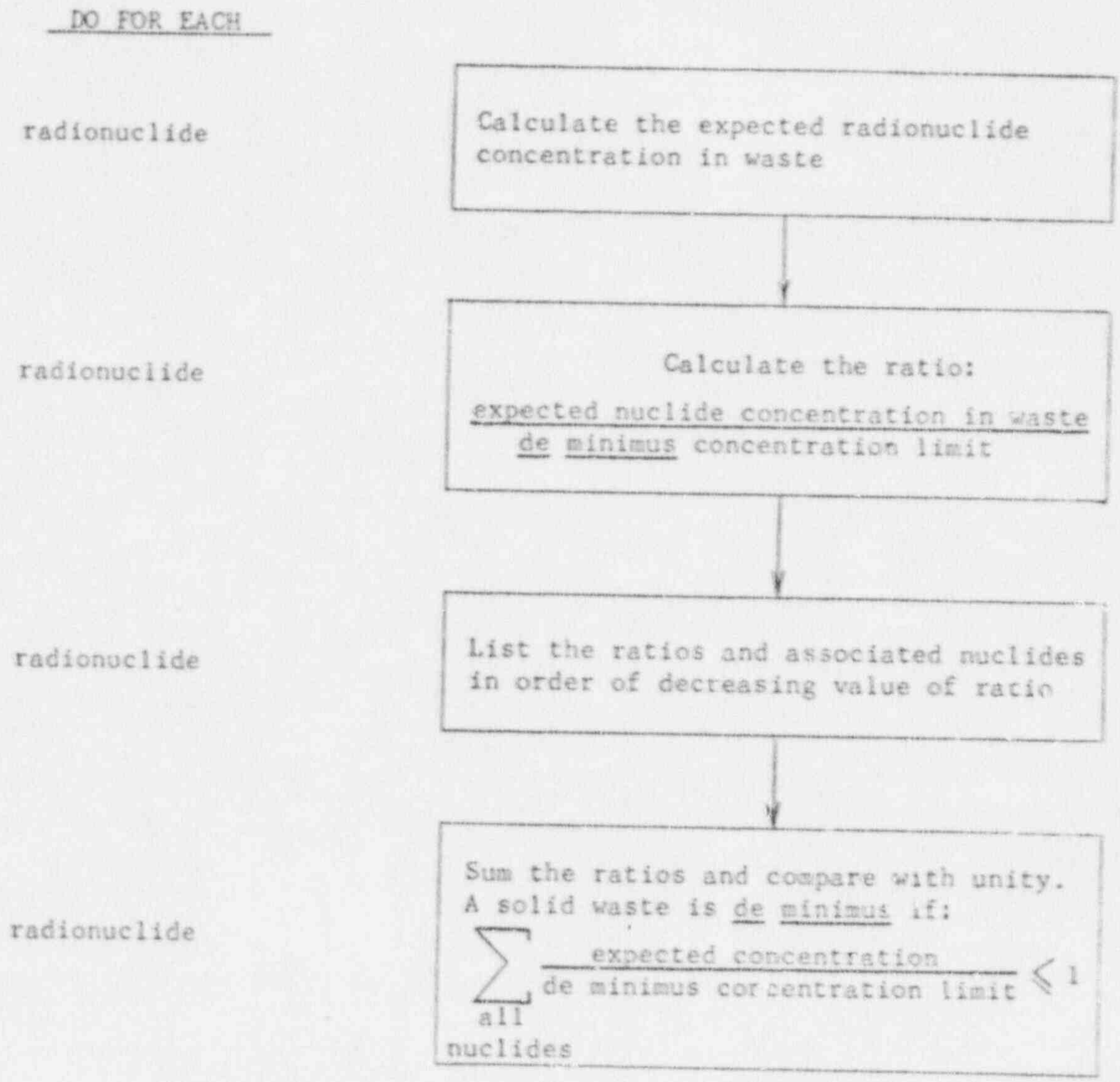

Figure 6-1 Summary Diagram of Method of Calculating Whether Waste Is "de minimus"

6.0 APPLICATION OF THE GENERIC METHOD

The aim of this study has been to develop a method for determining "de minimus" concentrations in homogeneous, bulk solid wastes so that they may be disposed of in the manner of ordinary domestic solid wastes without any special requirements because of the low radioactivity content. The methodology developed has been applied to land disposal of spent, powdered resin from PWR secondary systems as an example. Neither initial dispersion by air or water, i.e., incineration or sea dumping, were considered; however, the methodology developed can be applied to other materials by considering the nature of the source, feasible disposal scenarios, and environmental pathways to man.

6.1 Application to Secondary Resins

As an example of the application of the method, the expected concentration of each radionuclide adsorbed on spent, powdered resin from PWR secondary systems has been computed using the PWR GALE code (NRC76) to calculate primary coolant concentrations and the SECONDARY code (by Nuclear Safety Associates) to calculate activity concentrations of the spent resins. The "de minimus" concentrations calculated in Section 4 apply, of course, to this type of waste. By comparing the expected concentrations to the "de minimus" concentration limits, it is possible to rank the isotopes in order of significance. The sum of the ratios of expected to "de minimus" concentrations of all radionuclides in the waste must not exceed unity if the waste itself is to be "de minimus." This method is also summarized in Figure 6-1.

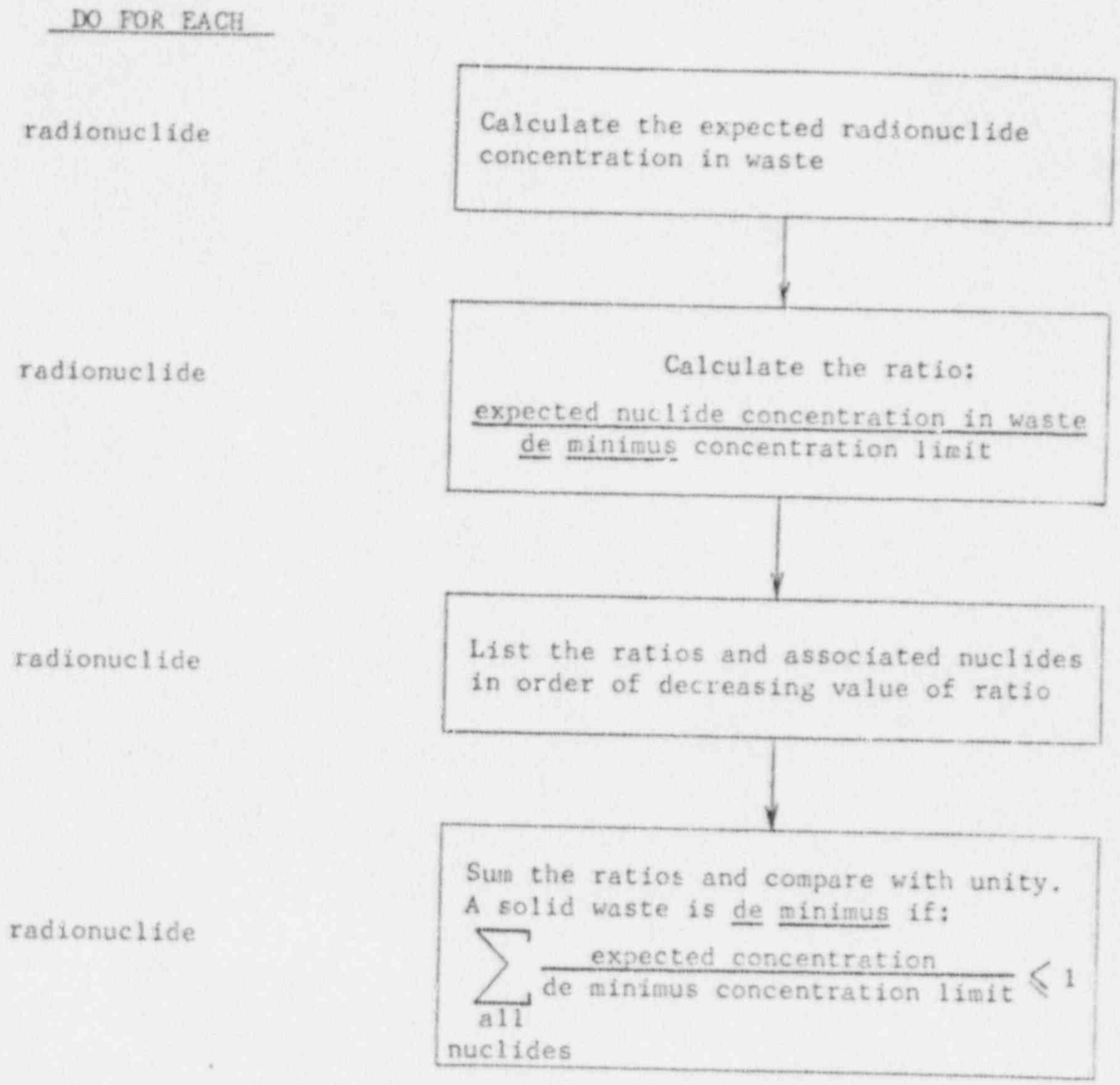

Figure 6-1 Summary Diagram of Method of Calculating Whether Waste Is "de minimus"

eters will be very much lower than the assumed values. Consequently, most of the time the secondary resins will have concentrations much below the "expected" values calculated herein and this type of waste can be expected to meet the "de minimus" concentration much of the time.

6.2 Practicability of Measurement

It can be seen from Tables 4-3 and 4-4, particularly the latter, that levels at which nuclides must be measured to demonstrate compliance with "de minimus" concentrations are in the range of 10^{-6} μCi/gram. In the case of a specific waste type, such as resins, where it can be demonstrated that only a few radionuclides are important, the number of radionuclides which need be analyzed for can be shown to be small. Furthermore, in the case of spent, powdered resins from PWR secondary systems where the critical radionuclides, Co-60 and Cs-137, emit distinct, energetic gamma rays, the analytical requirement is clear. In this example case, the limit of measurement of the critical nuclides by gamma ray spectrometry is in the order of 0.1 to 1 pCi/g. Both of these nuclides can be measured at the activity concentration necessary to demonstrate compliance with the "de minimus" concentration limits calculated in this study.

Table 6-1

Comparison of Computed Activity Concentrations in Spent Resin with "de minimus" Concentration Limits Appropriate for Land Disposal of Homogeneous Bulk Solid Waste

Activity on Resin Decayed for 3 Months Before Disposal

IN ORDER OF DECREASING RATIO OF EXPECTED TO LIMITING VALUES

ISOTOPE	TABLE	LIMITING CONCEN. (UCI/GM)	EXPECTED CONCEN. (UCI/GM)	RATIO OF EXP TO LIM CONCEN.
CS-134	76	9.9E-07	2.6E-04	262.5495
CS-137	52	1.5E-06	2.3E-04	156.3462
CO--60	76	8.1E-07	2.4E-05	29.6624
CO--58	76	2.6E-06	2.4E-05	9.1129
MN--54	76	2.4E-06	2.3E-06	.9575
FE--59	76	2.8E-06	5.7E-07	.2052
SR--90	129	7.5E-07	1.3E-07	.1736
TE127M	129	5.3E-06	7.7E-07	.1447
CE-144	76	3.6E-06	2.3E-07	.0645
ZR--95	76	2.1E-06	7.6E-08	.0360
TE129M	76	1.1E-05	3.9E-07	.0351
RU-106	76	2.4E-06	8.0E-08	.0335
NB--95	76	4.4E-06	1.4E-07	.0318
CS-136	46	3.7E-06	6.8E-08	.0182
SR--89	76	1.6E-05	2.6E-07	.0165
I--131	46	1.8E-05	2.1E-07	.0118
TE-129	41	6.3E-05	3.9E-07	.0061
PR-144	41	5.2E-05	2.3E-07	.0045
Y---90	46	3.4E-05	1.3E-07	.0038
FE--55	129	4.5E-03	1.7E-05	.0038
Y---91	76	1.9E-05	7.2E-08	.0038
RU-103	76	5.6E-06	1.9E-08	.0034
CR--51	76	1.0E-04	2.8E-07	.0028
TE-127	46	9.1E-04	7.6E-07	8.3E-04
TC--99	61	6.3E-08	4.3E-11	6.8E-04
TE125M	129	4.7E-05	2.9E-08	6.2E-04
CE-141	76	4.5E-05	1.7E-08	3.8E-04
BA-140	76	3.1E-06	1.0E-09	3.4E-04
LA-140	41	5.0E-06	1.2E-09	2.4E-04
RB--86	76	1.9E-05	2.8E-09	1.5E-04

TABLE 41 -- CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER NO DECAY
TABLE 42 -- CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.001 YEARS
TABLE 46 -- CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0 [illegible]
TABLE 52 -- CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER [illegible]
TABLE 61 -- CASE II-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 0.5 YEARS DECAY
TABLE 76 -- CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER NO DECAY
TABLE 1[illegible]4 -- CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER [illegible]
TABLE 124 -- CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER NO DECAY
TABLE 127 -- CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.1 YEARS DECAY
TABLE 129 -- CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER .5 YEARS DECAY

Table 6-2

Comparison of Computed Activity Concentrations in Spent Resin with "de minimus" Concentration Limits Appropriate for Land Disposal of Homogeneous Bulk Solid Waste

Activity on Resin Decayed for 6 Months Before Disposal

IN ORDER OF DECREASING RATIO OF EXPECTED TO LIMITING VALUES

ISOTOPE	TABLE	LIMITING CONCEN. (UCI/GM)	EXPECTED CONCEN. (UCI/GM)	RATIO OF EXP TO LIM CONCEN.
CS-134	76	9.9E-07	2.4E-04	241.7684
CS-137	52	1.5E-06	2.3E-04	155.4462
CO--60	76	8.1E-07	2.3E-05	28.6981
CO--58	76	2.6E-06	9.7E-06	3.7392
MN--54	76	2.4E-06	1.9E-06	.7818
SR--90	129	7.5E-07	1.3E-07	.1726
TE127M	129	5.3E-06	4.2E-07	.0792
CE-144	76	3.6E-06	1.9E-07	.0517
FE--59	76	2.8E-06	1.4E-07	.0503
RU-106	76	2.4E-06	6.8E-08	.0282
ZR--95	76	2.1E-06	2.9E-08	.0136
NB--95	76	4.4E-06	5.8E-08	.0132
TE129M	76	1.1E-05	6.0E-08	.0055
SR--89	76	1.6E-05	7.5E-08	.0047
Y---90	46	3.4E-05	1.3E-07	.0038
PR-144	41	5.2E-05	1.9E-07	.0036
FE--55	129	4.5E-03	1.6E-05	.0035
Y---91	76	1.9E-05	2.4E-08	.0013
TE-129	41	6.3E-05	6.0E-08	9.6E-04
RU-103	76	5.6E-06	4.0E-09	7.1E-04
TC--99	61	6.3E-08	4.3E-11	6.8E-04
TE-127	46	9.1E-04	4.2E-07	4.6E-04
CR--51	76	1.0E-04	2.9E-08	2.9E-04
TE125M	129	4.7E-05	9.8E-09	2.1E-04
CS-136	46	3.7E-06	5.2E-10	1.4E-04
CE-141	76	4.5E-05	2.4E-09	5.4E-05
RB--86	76	1.9E-05	9.5E-11	5. E-06
I--131	46	1.8E-05	8.2E-11	4.6E-06
BA-140	76	3.1E-06	7.4E-12	2.4E-06
LA-140	41	5.0E-06	8.6E-12	1.7E-06

TABLE 41 -- CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER NO DECAY
TABLE 42 -- CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.001 YEARS
TABLE 46 -- CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0 DECAY
TABLE 52 -- CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 5 YRS
TABLE 61 -- CASE II-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 0.5 YEARS DECAY
TABLE 76 -- CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER NO DECAY
TABLE 104 -- CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 5 YRS
TABLE 124 -- CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER NO DECAY
TABLE 127 -- CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER 0.1 YEARS DECAY
TABLE 129 -- CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 0.5 YEARS DECAY

Table 6-3

Comparison of Computed Activity Concentrations in Spent Resin with "de minimus" Concentration Limits Appropriate for Land Disposal of Homogeneous Bulk Solid Waste

Activity on Resin Decayed for One Year Before Disposal

IN ORDER OF DECREASING RATIO OF EXPECTED TO LIMITING VALUES

ISOTOPE	TABLE	LIMITING CONCEN. (UCI/GM)	EXPECTED CONCEN. (UCI/GM)	RATIO OF EXP TO LIM CONCEN.
CS-134	76	9.9E-07	2.0E-04	205.0108
CS-137	52	1.5E-06	2.3E-04	153.6618
CO--60	76	8.1E-07	2.2E-05	26.8626
CO--58	76	2.6E-06	1.6E-06	.6296
MN--54	76	2.4E-06	1.3E-06	.5212
SR--90	129	7.5E-07	1.3E-07	.1705
CE-144	76	3.6E-06	1.2E-07	.0331
TE127M	129	5.3E-06	1.3E-07	.0237
RU-106	76	2.4E-06	4.8E-08	.0199
Y---90	46	3.4E-05	1.3E-07	.0038
FE--55	129	4.5E-03	1.4E-05	.0031
FE--59	76	2.8E-06	8.5E-09	.0030
PR-144	41	5.2E-05	1.2E-07	.0023
NB--95	76	4.4E-06	8.7E-09	.0020
ZR--95	76	2.1E-06	4.1E-09	.0019
TC--99	61	6.3E-08	4.3E-11	6.8E-04
SR--89	76	1.6E-05	6.2E-09	3.9E-04
Y---91	76	1.9E-05	2.9E-09	1.5E-04
TE-127	46	9.1E-04	1.2E-07	1.4E-04
TE129M	76	1.1E-05	1.5E-09	1.3E-04
RU-103	76	5.6E-06	1.7E-10	3.0E-05
TE125M	129	4.7E-05	1.1E-09	2.4E-05
TE-129	41	6.3E-05	1.5E-09	2.3E-05
CR--51	76	1.0E-04	3.1E-10	3.1E-06
CE-141	76	4.5E-05	4.9E-11	1.1E-06
I--129	129	5.2E-07	1.1E-13	2.1E-07
PU-239	104	4.9E-05	4.2E-12	8.6E-08
CS-135	52	1.7E-04	3.7E-12	2.2E-08
CS-136	46	3.7E-06	3.1E-14	8.4E-09
RB--86	76	1.9E-05	1.1E-13	5.8E-09

TABLE 41 -- CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER NO DECAY
TABLE 42 -- CASE I-I -- SANITARY LANDFILL - EXPOSURE TO 55 GALLON DRUMS AFTER 0.001 YEARS
TABLE 46 -- CASE I-J -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO WORKERS AFTER 0 DECAY
TABLE 52 -- CASE I-K -- SANITARY LANDFILL - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 5 YR
TABLE 61 -- CASE II-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 0.5 YEARS DECAY
TABLE 76 -- CASE II-K -- FILL WANTED - GROUND SURFACE EXPOSURE TO RESIDENTS AFTER NO DECAY
TABLE 104 -- CASE III-D -- SANITARY LANDFILL - INHALATION DURING SITE EXCAVATION AFTER 5 YR
TABLE 124 -- CASE IV-E -- FILL WANTED DISPOSAL - CHILD EATS WASTE AFTER NO DECAY
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TABLE 129 -- CASE IV-F -- FILL WANTED DISPOSAL - FOOD GROWN IN WASTE AFTER 0.5 YEARS DECAY

REFERENCES

Ba 73 Barton, C.J. et.al, Contribution of Radon in Natural Gas to the Natural Radioactivity Dose in Homes, ORNL-TM-4154, Oak Ridge National Laboratory (1973).

BEIR 72 Advisory Committee on the Biological Effects of Ionizing Radiations. The Effects on Populations of Exposure to Low Levels of Ionizing Radiation, NSA-NRC (November, 1972).

EPA 76 Code of Federal Regulations, Title 40, Part 141, "Interim Primary Drinking Water Regulations," (July 9, 1976).

EPA 77 Environmental Protection Agency, Federal Register, 42 no. 230, pp. 60956-60959 (November 30, 1977).

Fla 77 Study of Radon Daughter Concentrations in Structures in Polk and Hillsborough Counties, State of Florida, Dept. Hlth & Rehab. Svc., Rad. Hlth Svc. (draft Nov. 1977).

Gi 72 Gitlin, J.N., "Preliminary Dose Estimates from the USPHS 1970 X-ray Exposure Study," paper presented at 49th Annual Meeting of the American College of Radiology (April 6, 1972).

IC 73 International Commission on Radiological Protection, Implications of Commission Recommendations that Doses by kept as Low as Readily Achievable, ICRP Publication 22, p. 6 (1973).

NC 75 National Council on Radiation Protection and Measurements, Natural Background Radiation in the United States, NCRP Report No. 45 (November 1975).

NC 75a National Council on Radiation Protection and Measurements, Review of the Current State of Radiation Protection Philosophy, NCRP Report No. 43 (January, 1975).

NRC 76 Nuclear Regulatory Commission Calculation of Releases of Radioactive Material in Gaseous and Liquid Effluent from Presurized Water Reactors PWR-GALE Code, NUREG-0017, NRC Off. Stds, Development (April 1976).

Oa 72 Oakley, D.T., Natural Radiation Exposure in the United States, PhD dissertation, also printed by USEPA as ORP/SID 72-1 (June, 1972).

Ra 64 Radford, E.P. Jr, & Hunt, V.R., "Polonium-210: A Volatile Radio-element in Cigarettes," Science, 143, 247 (1964).

Sh 76 Shleien, B., et al., The Mean Active Bone Marrow Dose from Dose from Diagnostic Radiology, FDA-77-8013, Bu. Rad. Hlth. (April 1976).

Un 72 United Nations Scientific Committee on the Effects of Atomic Radiation, Ionizing Radiation: Levels and Effects, 1, United Nations (1972).

Wi 77 Windham, S.T., et.al, The Effects of Home Ventilation Systems on Indoor Radon-Radon Daughter Levels, USEPA Office of Radiation Programs (1977).

RG 1.109 Regulatory Guide 1.109, "Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 50, Appendix I," US Nuclear Regulatory Commission (March, 1976).

Ye 72 Yeates, D.B. et.al., "Natural Radiation in the Urban Environment," Nuclear Safety, 13, 4, 275-286 (July-Aug., 1972).

APPENDIX A

EQUATIONS USED TO DETERMINE THE DOSE RATE FROM EACH NUCLIDE FOR EACH PATHWAY

Symbol Definitions

$\sum_{n=i}^{k}$	indicates that the dose rate is summed over the contributions from the nuclide and its daughters
A_b	is the vegetation consumption rate of the meat animal (kg/day)
A_m	is the vegetation consumption rate of the milk cow (kg/day)
B_{fn}	is the bioaccumulation factor for fish for the n-th nuclide (pCi/kg)/(pCi/liter)
B_{sn}	is the bioaccumulation factor for shellfish for the n-th nuclide (pCi/kg)/(pCi/liter)
C_{nt}	is the activity concentration of the n-th nuclide in the chain at the time of exposure t (pCi/gm)
D	is the dose rate resulting from a nuclide and its associated daughter products (mrem/yr)
DF_{1nj}	is the ingestion dose factor for the n-th nuclide and the j-th age group (mrem/pCi ingested)
DF_{2nj}	is the inhalation dose factor for the n-th nuclide and the j-th age group (mrem/pCi inhaled)
DF_{3n}	is the dose factor for a 55 gallon drum containing a solution of water and nuclide n (mrem/hr)/(pCi/gm)
DF_{4n}	is the dose factor for a semi-infinite medium of density 1 g/cc containing a uniformly distributed source of nuclide n (mrem/hr)/(pCi/gm)
E	is the quantity of soil eaten by child (g/yr)
F	is the fraction of waste which is spilled

G is the erosion rate ($g/m^2/yr$)

H is the erosion area (m^2)

I_{nat} is the inventory of nuclide n after a year of disposing waste at the site followed by t years of decay in transit to the watercourse (pCi)

K is the concentration of waste in the air (g/cubic meter)

L_n is the leach rate from the waste inventory (per year)

$$Q_{fm} = 1000 \frac{gm}{kg} * Svn * (U_v + U_m * A_m * Smn + U_b * A_b * S_{bn})$$

$$\frac{gm}{yr} = \frac{gm}{kg} * 1 * \left(\frac{kg}{yr} + \frac{kg}{yr} * \frac{kg}{day} * \frac{days}{kg} + \frac{1}{yr} * \frac{kg}{day} * \frac{days}{1}\right)$$

is the equivalent intake of vegetation in gms/yr through the food pathway (fruits and vegetables, milk, and meat)

$$Q_{wn} = (U_w + U_f * B_{fn} + U_s * B_{sn}) * 1000 \text{ cc/liter}$$

$$\frac{cc}{yr} = \left(\frac{1}{yr} + \frac{kg}{yr} * \frac{1}{kg} + \frac{kg}{yr} * \frac{1}{kg} * \frac{cc}{1}\right)$$

the equivalent intake of water through the watercourse pathways (includes drinking water, fish and shellfish)

R is the waste density (gm/cc)

S_{bn} is the stable element transfer factor for meat (days/kg)

S_{mn} is the stable element transfer factor for milk (days/liter)

S_{vn} is the stable element transfer factor for vegetation (pCi/gm vegetation)/(pCi/gm soil)

T_b is the duration of burial (years)

T_x is the duration of exposure (hrs/yr)

U_a is the breathing rate of the individual under consideration (cubic meters/yr)

Pathways C - Inhalation of Spilled waste

and D - Inhalation of Waste During Excavation

$$D = K * U_a * T_x \sum_{n=i}^{k} DF_{2nj} * C_{nt}$$

$$\frac{mrem}{yr} = \frac{gm}{m^3} * \frac{m^3}{hr} * \frac{hr}{yr} * \frac{mrem}{pCi} * \frac{pCi}{gm}$$

Pathway E - Child Eats Dirt on Waste Site

$$D = E * \sum_{n=i}^{k} DF_{1nj} * C_{nt}$$

$$\frac{mrem}{yr} = \frac{gm}{yr} * \frac{mrem}{pCi} * \frac{pCi}{gm\ soil}$$

Pathway F - Food Grown on Waste Site

$$D = \sum_{n=i}^{k} Q_{fm} * DF_{1nj} * C_{nt}$$

$$\frac{mrem}{yr} = \frac{gm}{yr} * \frac{mrem}{pCi} * \frac{pCi}{gm}$$

Pathway G - Erosion of Waste into Watercourse

$$D = \frac{G * H}{W} \sum_{n=i}^{k} Q_{wn} * DF_{1nj} * C_{nt}$$

$$\frac{mrem}{yr} = \frac{\left(\frac{gms}{m^2\text{-}yr}\right) * m^2}{\frac{cc}{yr}} * \frac{cc}{yr} * \frac{mrem}{pCi} * \frac{pCi}{gm}$$

Pathway H - Inhalation of Eroded Waste

same as pathways C and D

Pathway I - Direct Irradiation from 55 Gallon Drums

$$D = T_x \sum_{n=i}^{k} DF_{3n} * C_{nt}$$

$$\frac{mrem}{yr} = \frac{hrs}{yr} * \frac{mrem/hr}{pCi/gm} * \frac{pCi}{gm}$$

Pathways J and K - Direct Irradiation from Ground Surface

$$D = T_x \sum_{n=i}^{k} DF_{4n} * C_{nt}$$

$$\frac{mrem}{yr} = \frac{hrs}{yr} * \frac{mrem/hr}{pCi/gm} * \frac{pCi}{gm}$$

Note: For this pathway C_{nt} continues to decay during the exposure time.

APPENDIX B

COMPUTED RESULTS OF DISPOSAL SCENARIO-PATHWAY EVALUATIONS

Tables representing 15 of the most restrictive exposure pathways identified in Tables 4-4 and 4-6 are included in this appendix. The complete set of 143 tables are on file at the Atomic Industrial Forum.

TABLE 25

CASE I-E -- SANITARY LANDFILL -
CHILD EATS DIRT ON WASTE SITE AFTER 5 YEARS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	3.3E-01		
C---14	5.73E+03 YRS	2.2E-02		
NA--24	1.50E+01 HRS	1.0E+07		
P---32	1.43E+01 DYS	1.0E+07		
CR--51	2.78E+01 DYS	1.0E+07		
MN--54	3.12E+02 DYS	3.3E+00		
MN--56	2.58E+00 HRS	1.0E+07		
FE--55	2.40E+00 YRS	2.9E-02		
FE--59	4.50E+01 DYS	1.0E+07		
CO--58	7.10E+01 DYS	4.9E+05		
CO--60	5.24E+00 YRS	6.2E-03		
NI--59	8.00E+04 YRS	3.1E-02		
NI--63	9.21E+01 YRS	1.2E-02		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	1.0E+07		
ZN--65	2.43E+02 DYS	1.3E+00		
ZN--69	5.50E+01 MIN	1.0E+07		
BR--83	2.40E+00 HRS	1.0E+07		
BR--84	3.20E+01 MIN	1.0E+07		
BR--85	3.00E+00 MIN	1.0E+07		
RB--86	1.87E+01 DYS	1.0E+07		
RB--88	1.80E+01 MIN	1.0E+07		
RB--89D	1.50E+01 MIN	1.0E+07	SR--89	100.
SR--89	5.06E+01 DYS	1.0E+07		
SR--90	2.88E+01 YRS	1.8E-05		
SR--91D	9.70E+00 HRS	1.0E+07	Y---91	100.
SR--92	2.70E+00 HRS	1.0E+07		
Y---9	2.67E+00 DYS	1.0E+07		
Y--91MD	5.00E+01 MIN	1.0E+07	Y---91	100.
Y---91	5.90E+01 DYS	1.0E+07		
Y---92	3.53E+00 HRS	1.0E+07		
Y---93D	1.02E+01 HRS	1.0E+07	NB-93M	52.
ZR--93+D	1.50E+06 YRS	2.2E+01	NB-93M	52.
ZR--95+D	6.50E+01 DYS	1.0E+07	NB--95	38.
ZR--97	1.70E+01 HRS	1.0E+07		
NB-93M	3.7[illegible] YRS	6.2E+01		
NB--95	3.50E+01 DYS	1.0E+07		
NB--97	1.20E+00 HRS	1.0E+07		
MO--99D	2.79E+00 DYS	1.0E+07	TC--99	1[illegible].
TC-99MD	6.00E+00 HRS	1.0E+07	TC--99	100.
TC--99	2.1[illegible]E+05 YRS	1.0E+00		
RU-103	4.00E+01 DYS	1.0E+07		
RU-105	4.43E+00 HRS	1.0E+07		
RU-106	1.00E+00 YRS	1.1E+0[illegible]		
RH-105	1.5[illegible]E+00 DYS	1.0E+07		
AG110M	2.60E+02 DYS	7.4E+01		
TE125M	5.80E+01 DYS	1.0E+07		
TE127M+D	1.[illegible]5E+02 DYS	9.3E+03	TE-127	10.
TE-127	9.30E+00 HRS	1.0E+07		
TE129MD	3.40E+01 DYS	2.3E+05	I--129	100.

TABLE 25

CASE I-E -- SANITARY LANDFILL -
CHILD EATS DIRT ON WASTE SITE AFTER 5 YEARS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129D	1.12E+00 HRS	1.0E+07	I--129	100.
TE131MD	1.20E+00 DYS	1.0E+07	I--131	100.
TE-131D	2.50E+01 MIN	1.0E+07	I--131	100.
TE-132+D	3.25E+00 DYS	1.0E+07	I--132	4.
I--129	1.60E+07 YRS	1.3E-03		
I--130	1.24E+01 HRS	1.0E+07		
I--131	8.05E+00 DYS	1.0E+07		
I--132	2.30E+00 HRS	1.0E+07		
I--133	2.10E+01 HRS	1.0E+07		
I--134	5.30E+01 MIN	1.0E+07		
I--135D	6.70E+00 HRS	1.0E+07	CS-135	100.
CS-134	2.10E+00 YRS	3.2E-03		
CS-135	2.[illegible]E+06 YRS	6.3E-03		
CS-136	1.30E+01 DYS	1.0E+07		
CS-137	3.00E+01 YRS	1.2E-03		
CS-138	3.22E+01 MIN	1.0E+07		
BA-140	1.28E+01 DYS	1.0E+07		
BA-141D	1.8[illegible]E+01 MIN	1.0E+07	CE-141	100.
BA-142	1.10E+01 MIN	1.0E+07		
LA-140	1.67E+00 DYS	1.0E+07		
LA-141D	3.90E+00 HRS	1.0E+07	CE-141	100.
LA-142	1.40E+00 HRS	1.0E+07		
CE-141	3.25E+01 DYS	1.0E+07		
CE-143D	1.37E+00 DYS	1.0E+07	PR-143	100.
CE-144	2.85E+02 DYS	3.7E+01		
PR-143	1.37E+01 DYS	1.0E+07		
PR-144	1.73E+01 MIN	1.0E+07		
ND-147D	1.11E+01 DYS	5.6E+03	PM-147	100.
PM-147	2.60E+00 YRS	6.6E+01		
W--187	2.40E+01 HRS	1.0E+07		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	2.3E-07		
AC-227+D	2.16E+01 YRS	5.4E-05	RA-223	90.
TH-227D	1.82E+01 DYS	1.0E+07	RA-223	100.
PA-231+D	3.25E+04 YRS	1.6E-04	RA-223	44.
U--235	7.10E+08 YRS	1.0E-03		
NP-239D	2.35E+00 DYS	5.8E+03	PU-239	100.
PU-239	2.44E+04 YRS	1.5E-03		

BASED ON: A MAXIMUM DOSE COMMITMENT OF 1.00 MREM/YR TO CHILDREN
WHO EAT .10 KG OF DIRT IN A GIVEN YEAR
DECAY TIME FROM BURIAL TO INGESTION = 5.0E+00 YEARS
FRACTION OF SOIL WHICH IS WASTE = .20

TABLE 29

CASE I-F -- SANITARY LANDFILL -
FOOD GROWN ON WASTE SITE AFTER 5 YEARS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	6.6E-05		
C---14	5.73E+03 YRS	9.1E-06		
NA--24	1.50E+01 HRS	1.0E+07		
P---32	1.43E+01 DYS	1.0E+07		
CR--51	2.78E+01 DYS	1.0E+07		
MN--54	3.12E+02 DYS	1.5E-01		
MN--56	2.58E+00 HRS	1.0E+07		
FE--55	2.40E+00 YRS	4.6E-02		
FE--59	4.50E+01 DYS	1.0E+07		
CO--58	7.1[illegible]E+01 DYS	2.[illegible]E+05		
CO--60	5.24E+00 YRS	2.5E-03		
NI--59	8.[illegible]1E+04 YRS	1.3E-03		
NI--63	9.21E+01 YRS	4.9E-04		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	1.0E+07		
ZN--65	2.43E+02 DYS	8.5E-04		
ZN--69	5.50E+01 MIN	1.0E+07		
BR--83	2.40E+00 HRS	1.0E+07		
BR--84	3.20E+01 MIN	1.0E+07		
BR--85	3.[illegible]E+00 MIN	1.0E+07		
RB--86	1.87E+01 DYS	1.0E+07		
RB--88	1.80E+01 MIN	1.0E+07		
RB--89D	1.50E+01 MIN	1.0E+07	SR--89	100.
SR--89	5.06E+01 DYS	1.0E+07		
SR--90	2.88E+01 YRS	2.2E-06		
SR--91D	9.70E+00 HRS	1.0E+07	Y---91	100.
SR--92	2.70E+00 HRS	1.0E+07		
Y---90	2.67E+00 DYS	1.0E+07		
Y--91MD	5.00E+01 MIN	1.0E+07	Y---91	100.
Y---91	5.90E+01 DYS	1.0E+07		
Y---92	3.53E+00 HRS	1.0E+07		
Y---93D	1.02E+01 HRS	1.0E+07	NB-93M	99.
ZR--93+D	1.50E+06 YRS	2.5E+00	NB-93M	99.
ZR--95+D	6.50E+01 DYS	1.0E+07	NB--95	98.
ZR--97	1.7[illegible]E+01 HRS	1.0E+07		
NB-93M	3.7[illegible]E+[illegible] YRS	3.9E+0[illegible]		
NB--95	3.50E+01 DYS	1.0E+07		
NB--97	1.20E+00 HRS	1.0E+07		
MO--99D	2.79E+00 DYS	2.9E+04	TC--99	100.
TC-99MD	6.00E+00 HRS	3.2E+05	TC--99	100.
TC--99	2.1[illegible]E+05 YRS	1.1E-03		
RU-103	4.00E+01 DYS	1.0E+07		
RU-105	4.43E+00 HRS	1.0E+07		
RU-106	1.00E+00 YRS	5.0E-02		
RH-105	1.50E+00 DYS	1.0E+07		
AG110M	2.6[illegible]E+02 DYS	1.1E-01		
TE125M	5.80E+01 DYS	3.1E+05		
TE127M+D	1.[illegible]5E+02 DYS	7.[illegible]E+00	TE-127	3.
TE-127	9.30E+00 HRS	1.0E+07		
TE129MD	3.40E+01 DYS	3.8E+04	I--129	100.

TABLE 29

CASE I-F -- SANITARY LANDFILL -
FOOD GROWN ON WASTE SITE AFTER 5 YEARS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129D	1.12E+00 HRS	1.0E+07	I--129	100.
TE131MD	1.20E+00 DYS	1.0E+07	I--131	100.
TE-131D	2.50E+01 MIN	1.0E+07	I--131	100.
TE-132	3.25E+00 DYS	1.0E+07		
I--129	1.60E+07 YRS	2.2E-04		
I--130	1.24E+01 HRS	1.0E+07		
I--131	8.05E+00 DYS	1.0E+07		
I--132	2.30E+00 HRS	1.0E+07		
I--133	2.10E+01 HRS	1.0E+07		
I--134	5.30E+01 MIN	1.0E+07		
I--135D	6.70E+00 HRS	1.0E+07	CS-135	100.
CS-134	2.10E+00 YRS	9.7E+05		
CS-135	2.00E+06 YRS	1.3E-04		
CS-136	1.30E+01 DYS	3.7E-04		
CS-137	3.00E+01 YRS	1.0E+07		
CS-138	3.22E+01 MIN	4.5E-05		
BA-140	1.28E+01 DYS	1. E+07		
BA-141D	1.80E+01 MIN	1.0E+07	CE-141	100.
BA-142	1.10E+01 MIN	1.0E+07		
LA-140	1.67E+00 DYS	1.0E+07		
LA-141D	3.90E+00 HRS	1.0E+07	CE-141	100.
LA-142	1.40E+00 HRS	1.0E+07		
CE-141	3.25E+01 DYS	1.0E+07		
CE-143D	1.37E+00 DYS	1.0E+07	PR-143	100.
CE-144	2.85E+02 DYS	1.0E+07		
PR-143	1.37E+01 DYS	8.1E+01		
PR-144	1.73E+01 MIN	1.0E+07		
ND-147D	1.11E+01 DYS	1.0E+07	PM-147	100.
PM-147	2.60E+00 YRS	2.9E+03		
W--187	2.40E+01 HRS	3.5E+01		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	1.0E+07		
AC-227+D	2.16E+01 YRS	5.0E-07	RA-223	64.
TH-227D	1.82E+01 DYS	8.4E-05	RA-223	100.
PA-231+D	3.25E+04 YRS	1.0E+07	RA-223	13.
U--235	7.10E+08 YRS	1.0E-04		
NP-239D	2.35E+00 DYS	5.2E-04	PU-239	100.
PU-239	2.44E+04 YRS	5.4E+04		
		1.4E-02		

BASED ON: CONSUMPTION OF FOOD GROWN ON WASTE SITE
A MAXIMUM DOSE COMMITMENT OF 1.00 MREM/YR TO ADULTS
DECAY TIME FROM BURIAL TO INGESTION = 5.0E+00 YEARS
CONSUMPTION OF 190. KG OF FRUITS AND VEGETABLES PER YEAR
CONSUMPTION OF 310. LITERS OF MILK PER YEAR
CONSUMPTION OF 11. KG OF MEAT PER YEAR
CONSUMPTION RATE OF COW = 50. KG/DAY
CONSUMPTION RATE OF CATTLE = 50. KG/DAY
FRACTION OF SOIL WHICH IS WASTE = .10

TABLE 41

CASE I-I -- SANITARY LANDFILL -
EXPOSURE TO 55 GALLON DRUMS AFTER NO DECAY

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	1.0E+07		
C---14	5.73E+03 YRS	8.2E-02		
NA--24	1.50E+01 HRS	2.9E-06		
P---32	1.43E+01 DYS	1.6E-04		
CR--51	2.78E+01 DYS	2.2E-04		
MN--54	3.12E+02 DYS	1.2E-05		
MN--56	2.58E+00 HRS	5.8E-06		
FE--55	2.40E+00 YRS	1.0E+07		
FE--59	4.50E+01 DYS	9.0E-06		
CO--58	7.1[illegible]E+01 DYS	9.4E-06		
CO--60	5.24E+00 YRS	4.5E-06		
NI--59	8.01E+04 YRS	1.[illegible]E+07		
NI--63	9.21E+01 YRS	1.0E+07		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	3.8E-05		
ZN--65	2.43E+02 DYS	1.[illegible]E-05		
ZN--69	5.50E+01 MIN	7.0E-04		
BR--83	2.40E+00 HRS	4.4E-04		
BR--84	3.20E+01 MIN	4.9E-06		
ER--85	3.[illegible]E+00 MIN	8.3E-05		
RB--86	1.87E+01 DYS	7.1E-05		
RB--88	1.80E+01 MIN	1.1E-05		
RB--89	1.50E+01 MIN	4.6E-06		
SP--89	5.[illegible]6E+01 DYS	2.3E-04		
SR--90	2.88E+01 YRS	2.5E-03		
SR--91	9.70E+00 HRS	1.3E-05		
SR--92	2.70E+00 HRS	7.9E-06		
Y---90	2.67E+00 DYS	1.[illegible]E-04		
Y--91M	5.[illegible]E+01 MIN	1.3E-05		
Y---91	5.90E+01 DYS	3.0E-04		
Y---92	3.53E+00 HRS	2.3E-05		
Y---93	1.02E+01 HRS	3.4E-05		
ZR--93	1.50E+06 YRS	3.2E+01		
ZR--95	6.50E+01 DYS	1.2E-05		
ZR--97	1.70E+01 HRS	4.7E-05		
NB-93M	3.70E+00 YRS	5.7E-01		
NB--95	3.50E+01 DYS	1.2E-05		
NB--97	1.20E+00 HRS	1.2E-05		
MO--99	2.79E+00 DYS	5.8E-05		
TC-99M	6.[illegible]0E+00 HRS	8.7E-05		
TC--99	2.10E+05 YRS	1.3E-02		
RU-103	4.[illegible]0E+01 DYS	1.5E-05		
RU-105	4.43E+00 HRS	1.2E-05		
RU-106	1.[illegible]E+00 YRS	4.4E+03		
RH-105	1.50E+00 DYS	8.7E-05		
AG110M	2.60E+02 DYS	3.7E-06		
TE125M	5.80E+01 DYS	2.3E-02		
TE127M	1.[illegible]5E+02 DYS	1.[illegible]E-01		
TE-127	9.30E+00 HRS	1.1E-03		
TE129M	3.40E+01 DYS	1.9E-04		

TABLE 41

CASE I-I -- SANITARY LANDFILL
EXPOSURE TO 55 GALLON DRUMS AFTER NO DECAY

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129	1.12E+00 HRS	6.3E-05		
TE131M	1.20E+00 DYS	8.1E-06		
TE-131	2.50E+01 MIN	2.2E-05		
TE-132	3.25E+00 DYS	3.9E-05		
I--129	1.60E+07 YRS	2.2E-02		
I--130	1.24E+01 HRS	3.9E-06		
I--131	8.05E+00 DYS	2.1E-05		
I--132	2.30E+00 HRS	3.7E-06		
I--133	2.10E+01 HRS	1.5E-05		
I--134	5.30E+01 MIN	4.9E-06		
I--135	6.70E+00 HRS	5.9E-06		
CS-134	2.10E+00 YRS	5.2E-06		
CS-135	2.00E+06 YRS	3.6E-02		
CS-136	1.30E+01 DYS	4.6E-06		
CS-137	3.00E+01 YRS	2.2E-03		
CS-138	3.22E+01 MIN	4.7E-06		
BA-140	1.28E+01 DYS	3.2E-05		
BA-141	1.80E+01 MIN	1.8E-05		
BA-142	1.10E+01 MIN	1.6E-05		
LA-140	1.67E+00 DYS	5.0E-06		
LA-141	3.90E+00 HRS	7.4E-05		
LA-142	1.40E+00 HRS	5.2E-06		
CE-141	3.25E+01 DYS	1.6E-04		
CE-143	1.37E+00 DYS	2.9E-05		
CE-144	2.85E+02 DYS	6.0E-04		
PR-143	1.37E+01 DYS	1.2E-05		
PR-144	1.73E+01 MIN	5.2E-05		
ND-147	1.11E+01 DYS	5.7E-05		
PM-147	2.60E+00 YRS	2.9E-02		
W--187	2.40E+01 HRS	1.9E-05		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	2.0E-03		
AC-227	2.16E+01 YRS	7.9E-03		
TH-227	1.82E+01 DYS	1.0E+07		
PA-231	3.25E+04 YRS	1.0E+07		
U--235	7.10E+08 YRS	1.0E+07		
NP-239	2.35E+00 DYS	1.0E+07		
PU-239	2.44E+04 YRS	6.8E-01		

BASED ON: EXTERNAL EXPOSURE TO 55 GALLON DRUM OF WASTE
A MAXIMUM DOSE COMMITMENT OF 1.00 MREM/YR
EXPOSURE TIME = 1.0E+02 HOURS/YEAR
DECAY TIME PRIOR TO EXPOSURE = 0. YEARS
WASTE DENSITY = 1.0 GM/CC

TABLE 42

CASE I-I -- SANITARY LANDFILL -
EXPOSURE TO 55 GALLON DRUMS AFTER 0.001 YEARS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	1.0E+07		
C---14	5.73E+03 YRS	8.2E-02		
NA--24	1.50E+01 HRS	4.3E-06		
P---32	1.43E+01 DYS	1.7E-04		
CR--51	2.78E+01 DYS	2.2E-04		
MN--54	3.12E+02 DYS	1.2E-05		
MN--56	2.58E+00 HRS	6.3E-05		
FE--55	2.40E+00 YRS	1.0E+07		
FE--59	4.50E+01 DYS	9.1E-06		
CO--58	7.1[illegible]E+01 DYS	9.4E-06		
CO--60	5.24E+00 YRS	4.5E-06		
NI--59	8.01E+04 YRS	1.[illegible]E+07		
NI--63	9.21E+01 YRS	1.0E+07		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	6.0E-05		
ZN--65	2.43E+02 DYS	1.7E-05		
ZN--69	5.50E+01 MIN	5.3E-01		
BR--83	2.40E+00 HRS	5.5E-03		
BR--84	3.20E+01 MIN	4.3E-01		
BR--85D	3.00E+00 MIN	2.1E-02	KR-85M	100.
RB--86	1.87E+01 DYS	7.2E-05		
RB--88	1.80E+01 MIN	6.9E+03		
RB--89D	1.50E+01 MIN	1.1E+00	SR--89	100.
SR--89	5.[illegible]6E+01 DYS	2.3E-04		
SR--90+D	2.88E+01 YRS	7.7E-04	Y---90	69.
SR--91+D	9.70E+00 HRS	1.4E-05	Y--91M	39.
SR--92+D	2.70E+00 HRS	4.2E-05	Y---92	44.
Y---90	2.67E+00 DYS	1.1E-04		
Y--91M+D	5.00E+01 MIN	1.8E-02	Y---91	3.
Y---91	5.90E+01 DYS	3.0E-04		
Y---92	3.53E+00 HRS	1.3E-04		
Y---93	1.[illegible]E+01 HRS	6.1E-05		
ZR--93	1.5[illegible]E+06 YRS	3.2E+01		
ZR--95	6.50E+01 DYS	1.2E-05		
ZR--97+D	1.70E+01 HRS	7.5E-06	NB--97	48.
NB-93M	3.7[illegible]E+00 YRS	5.7E-01		
NB--95	3.50E+01 DYS	1.2E-05		
NB--97	1.20E+00 HRS	1.8E-03		
MO--99+D	2.79E+00 DYS	4.6E-05	TC-99M	28.
TC-99M	6.[illegible]0E+00 HRS	2.4E-04		
TC--99	2.10E+05 YRS	1.3E-02		
RU-103	4.[illegible]0E+01 DYS	1.6E-05		
RU-105+D	4.43E+00 HRS	4.4E-05	RH-105	4.
RU-106D	1.[illegible]0E+00 YRS	2.2E-05	RH-106	100.
RH-105	1.5[illegible]E+00 DYS	1.0E-04		
AG110M	2.60E+02 DYS	3.7E-06		
TE125M	5.80E+01 DYS	2.3E-02		
TE127M+D	1.[illegible]5E+02 DYS	2.2E-03	TE-127	99.
TE-127	9.30E+00 HRS	2.0E-03		
TE129M+D	3.40E+01 DYS	4.8E-05	TE-129	75.

TABLE 42

CASE I-I -- SANITARY LANDFILL -
EXPOSURE TO 55 GALLON DRUMS AFTER 0.001 YEARS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129	1.12E+00 HRS	1.5E-02		
TE131M+D	1.20E+00 DYS	9.2E-06	TE-131	7.
TE-131D	2.5[illegible]E+01 MIN	1.[illegible]E-02	I--131	100.
TE-132+D	3.25E+00 DYS	3.9E-06	I--132	91.
I--129	1.60E+07 YRS	2.2E-02		
I--13[illegible]	1.24E+01 HRS	6.3E-06		
I--131	8.05E+00 DYS	2.2E-05		
I--132	2.30E+00 HRS	5.2E-05		
I--133	2.10E+01 HRS	2.1E-05		
I--134	5.30E+01 MIN	4.7E-03		
I--135+D	6.70E+00 HRS	1.2E-05	XE-135	11.
CS-134	2.10E+00 YRS	5.2E-06		
CS-135	2.[illegible]E+06 YRS	3.6E-02		
CS-136	1.30E+01 DYS	4.7E-06		
CS-137+D	3.00E+01 YRS	1.3E-05	BA137M	99.
CS-138	3.22E+01 MIN	3.9E-[illegible]1		
BA-140+D	1.28E+01 DYS	1.7E-05	LA-140	48.
BA-141D	1.80E+01 MIN	4.2E-03	LA-141	99.
BA-142D	1.10E+01 MIN	2.7E-03	LA-142	100.
LA-140	1.67E+[illegible] DYS	5.8E-[illegible]6		
LA-141	3.9[illegible]E+[illegible]0 HRS	3.5E-[illegible]4		
LA-142	1.40E+00 HRS	4.0E-04		
CE-141	3.25E+01 DYS	1.6E-04		
CE-143+D	1.37E+[illegible]0 DYS	3.4E-05	PR-143	5.
CE-144+D	2.85E+02 DYS	4.8E-05	PR-144	93.
PR-143	1.37E+01 DYS	1.2E-05		
PR-144	1.73E+01 MIN	7.2E+04		
ND-147	1.11E+01 DYS	5.8E-05		
PM-147	2.60E+00 YRS	2.9E-02		
W--187	2.40E+01 HRS	2.4E-05		
RA-223	1.14E+01 DYS	[illegible].0E+07		
RA-226	1.60E+03 YRS	2.0E-03		
AC-227	2.16E+01 YRS	7.8E-03		
TH-227+D	1.82E+01 DYS	1.0E+07	RA-223	2.
PA-231D	3.25E+04 YRS	2.4E+02	AC-227	100.
U--235	7.10E+08 YRS	1.[illegible]E+07		
NP-239D	2.35E+00 DYS	1.0E+07	PU-239	100.
PU-239	2.44E+04 YRS	6.[illegible]E-01		

BASED ON: EXTERNAL EXPOSURE TO 55 GALLON DRUM OF WASTE
A MAXIMUM DOSE COMMITMENT OF 1.[illegible] MREM/YR
EXPOSURE TIME = 1.0E+02 HOURS/YEAR
DECAY TIME PRIOR TO EXPOSURE = 1.0E-03 YEARS
WASTE DENSITY = 1.0 GM/CC

TABLE 46

CASE I-J -- SANITARY LANDFILL -
GROUND SURFACE EXPOSURE TO WORKERS AFTER 0 DECAY

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	1.0E+07		
C---14	5.73E+03 YRS	1.8E-03		
NA--24	1.50E+01 HRS	8.1E-06		
P---32	1.43E+01 DYS	4.9E-05		
CR--51	2.78E+01 DYS	1.8E-04		
MN--54	3.12E+02 DYS	8.7E-06		
MN--56	2.58E+00 HRS	1.0E-04		
FE--55	2.4[illegible]E+[illegible] YRS	1.0E+07		
FE--59	4.50E+01 DYS	6.4E-06		
CO--58	7.[illegible]E+01 DYS	7.2E-06		
CO--60	5.24E+00 YRS	3.2E-06		
NI--59	8.01E+04 YRS	1.0E+07		
NI--63	9.21E+01 YRS	1.0E+07		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	1.5E-04		
ZN--65	2.43E+02 DYS	1.2E-05		
ZN--69	5.50E+01 MIN	6.1E-03		
BR--83+D	2.40E+00 HRS	2.4E-03	KR-83M	2.
BR--84	3.20E+01 MIN	3.7E-04		
BR--85+D	3.00E+00 MIN	1.7E-02	KR-85M	34.
RB--86	1.87E+01 DYS	2.6E-05		
RB--88	1.80E+01 MIN	1.1E-03		
RB--89	1.50E+01 MIN	8.1E-04		
SR--89	5.[illegible]E+01 DYS	4.0E-05		
SR--90+D	2.88E+01 YRS	4.2E-05	Y---90	77.
SR--91+D	9.70E+00 HRS	3.7E-05	Y--91M	32.
SR--92+D	2.70E+00 HRS	8.1E-05	Y---92	36.
Y---90	2.67E+00 DYS	3.4E-05		
Y--91M	5.[illegible]0E+01 MIN	7.9E-04		
Y---91	5.90E+01 DYS	5.0E-05		
Y---92	3.53E+00 HRS	1.7E-04		
Y---93	1.02E+01 HRS	8.0E-05		
ZR--93	1.50E+06 YRS	3.2E-02		
ZR--95+D	6.50E+01 DYS	8.7E-06	NB--95	4.
ZR--97+D	1.70E+01 HRS	1.4E-05	NB--97	45.
NB-93M	3.70E+00 YRS	1.3E-04		
NB--95	3.5[illegible]E+01 DYS	9.0E-06		
NB--97	1.20E+00 HRS	4.4E-04		
MO--99+D	2.79E+00 DYS	3.3E-05	TC-99M	25.
TC-99M	6.[illegible]0E+00 HRS	8.2E-04		
TC--99	2.10E+05 YRS	5.7E-04		
RU-103	4.[illegible]0E+01 DYS	1.2E-05		
RU-105+D	4.43E+00 HRS	1.1E-04	RH-105	11.
RU-106D	1.[illegible]E+00 YRS	8.[illegible]E-06	RH-106	100.
RH-105	1.[illegible]E+00 DYS	1.2E-04		
AG110M	2.60E+02 DYS	2.7E-06		
TE125M	5.80E+01 DYS	1.9E-03		
TE127MD	1.[illegible]5E+02 DYS	1.4E-04	TE-127	100.
TE-127	9.3[illegible]E+00 HRS	9.1E-04		
TE129M+D	3.40E+01 DYS	2.3E-05	TE-129	82.

TABLE 46

CASE I-J -- SANITARY LANDFILL -
GROUND SURFACE EXPOSURE TO WORKERS AFTER 0 DECAY

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129	1.12E+00 HRS	1.7E-03		
TE131M+D	1.20E+00 DYS	1.3E-05	TE-131	8.
TE-131+D	2.50E+01 MIN	1.6E-03	I--131	18.
TE-132+D	3.25E+00 DYS	3.7E-06	I--132	92.
I--129	1.60E+07 YRS	1.1E-03		
I--130	1.24E+01 HRS	1.6E-05		
I--131	8.05E+00 DYS	1.[illegible]E-05		
I--132	2.30E+00 HRS	7.9E-05		
I--133+D	2.10E+01 HRS	3.[illegible]E-05	XE-133	2.
I--134	5.30E+01 MIN	2.5E-04		
I--135+D	6.70E+00 HRS	3.2E-05	XE-135	15.
CS-134	2.10E+00 YRS	3.9E-06		
CS-135	2.00E+06 YRS	1.2E-03		
CS-136	1.31E+01 DYS	3.7E-06		
CS-137+D	3.00E+01 YRS	9.1E-06	BA137M	95.
CS-138	3.22E+01 MIN	3.7E-04		
BA-140+D	1.28E+01 DYS	5.1E-06	LA-140	77.
BA-141+D	1.80E+01 MIN	1.4E-03	LA-141	32.
BA-142+D	1.10E+01 MIN	8.7E-04	LA-142	79.
LA-140	1.67E+00 DYS	6.7E-06		
LA-141+D	3.90E+00 HRS	3.2E-04	CE-141	2.
LA-142	1.40E+00 HRS	1.5E-04		
CE-141	3.25E+01 DYS	8.3E-05		
CE-143+D	1.37E+00 DYS	2.8E-05	PR-143	34.
CE-144+D	2.85E+02 DYS	1.3E-05	PR-144	96.
PR-143	1.37E+01 DYS	4.8E-06		
PR-144	1.73E+01 MIN	3.3E-03		
ND-147	1.11E+01 DYS	3.7E-05		
PM-147	2.60E+00 YRS	9.9E-04		
W--187	2.40E+01 HRS	4.0E-05		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	1.6E-03		
AC-227	2.16E+01 YRS	5.1E-04		
TH-227+D	1.82E+01 DYS	1.0E+07	RA-223	11.
PA-231	3.25E+04 YRS	1.0E+07		
U--235	7.10E+08 YRS	1.0E+07		
NP-239D	2.35E+00 DYS	2.6E+06	PU-239	100.
PU-239	2.44E+04 YRS	3.0E-01		

BASED ON: EXTERNAL EXPOSURE TO BURIED WASTE
A MAXIMUM DOSE COMMITMENT OF 1.00 MREM/YR
EXPOSURE TIME = 1.0E+02 HOURS
DECAY TIME FROM BURIAL TO EXPOSURE = 0. YEARS
WASTE DENSITY = 1.0 GM/CC
FRACTION OF SOIL WHICH IS WASTE = 1.0E+00

TABLE 47

CASE I-J -- SANITARY LANDFILL -
GROUND SURFACE EXPOSURE TO WORKERS AFTER .001 YR

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	1.0E+07		
C---14	5.73E+03 YRS	1.8E-03		
NA--24	1.50E+01 HRS	1.2E-05		
P---32	1.43E+01 DYS	5.0E-05		
CR--51	2.78E+01 DYS	1.8E-04		
MN--54	3.12E+02 DYS	8.8E-06		
MN--56	2.58E+00 HRS	1.1E-03		
FE--55	2.40E+00 YRS	1.0E+07		
FE--59	4.50E+01 DYS	6.5E-06		
CO--58	7.10E+01 DYS	7.2E-06		
CO--60	5.24E+00 YRS	3.2E-06		
NI--59	8.01E+04 YRS	1.0E+07		
NI--63	9.21E+01 YRS	1.0E+07		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	2.4E-04		
ZN--65	2.43E+02 DYS	1.2E-05		
ZN--69	5.50E+01 MIN	4.6E+00		
BR--83+D	2.40E+00 HRS	2.9E-02	KR-83M	6.
BR--84	3.20E+01 MIN	3.2E+01		
BR--85D	3.00E+00 MIN	1.9E-01	KR-85M	100.
RB--86	1.87E+01 DYS	2.6E-05		
RB--88	1.80E+01 MIN	7.0E+05		
RB--89D	1.50E+01 MIN	2.0E-01	SR--89	100.
SR--89	5.06E+01 DYS	4.0E-05		
SR--90+D	2.88E+01 YRS	3.3E-05	Y---90	79.
SR--91+D	9.70E+00 HRS	6.7E-05	Y--91M	34.
SR--92+D	2.70E+00 HRS	3.7E-04	Y---92	69.
Y---90	2.67E+00 DYS	3.8E-05		
Y--91M+D	5.00E+01 MIN	8.1E-02	Y---91	93.
Y---91	5.90E+01 DYS	5.0E-05		
Y---92	3.53E+00 HRS	9.5E-04		
Y---93	1.02E+01 HRS	1.4E-04		
ZR--93+D	1.50E+06 YRS	3.1E-02	NB-93M	4.
ZR--95+D	6.50E+01 DYS	8.6E-06	NB--95	5.
ZR--97+D	1.70E+01 HRS	2.9E-05	NB--97	47.
NB-93M	3.70E+00 YRS	1.3E-04		
NB--95	3.50E+01 DYS	9.1E-06		
NB--97	1.20E+00 HRS	7.0E-02		
MO--99+D	2.79E+00 DYS	3.5E-05	TC-99M	26.
TC-99M	6.00E+00 HRS	2.3E-03		
TC--99	2.12E+05 YRS	5.7E-04		
RU-103	4.00E+01 DYS	1.2E-05		
RU-105+D	4.43E+00 HRS	3.3E-04	RH-105	32.
RU-106D	1.00E+00 YRS	8.9E-06	RH-106	100.
RH-105	1.50E+00 DYS	1.4E-04		
AG110M	2.60E+02 DYS	2.7E-06		
TE125M	5.80E+01 DYS	1.9E-03		
TE127MD	1.05E+02 DYS	1. E-04	TE-127	100.
TE-127	9.30E+00 HRS	1.7E-03		
TE129M+D	3.40E+01 DYS	2.3E-05	TE-129	83.

TABLE 47

CASE I-J -- SANITARY LANDFILL -
GROUND SURFACE EXPOSURE TO WORKERS AFTER .001 YR

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129	1.12E+00 HRS	3.8E-01		
TE131M+D	1.2[illegible]E+00 DYS	1.6E-05	I--131	9.
TE-131D	2.50E+01 MIN	8.8E-03	I--131	100.
TE-132+D	3.25E+00 DYS	3.8E-06	I--132	92.
I--129	1.60E+07 YRS	1.1E-03		
I--130	1.24E+01 HRS	2.6E-05		
I--131	8.05E+00 DYS	1.9E-05		
I--132	2.30E+00 HRS	1.1E-03		
I--133+D	2.10E+01 HRS	4.5E-05	XE-133	2.
I--134	5.30E+01 MIN	2.5E-01		
I--135+D	6.70E+00 HRS	6.[illegible]E-05	XE-135	26.
CS-134	2.10E+00 YRS	3.8E-06		
CS-135	2.00E+06 YRS	1.2E-03		
CS-136	1.30E+01 DYS	3.8E-06		
CS-137+D	3.[illegible]E+01 YRS	9.1E-06	BA137M	95.
CS-138	3.22E+01 MIN	3.1E+01		
BA-140+D	1.28E+01 DYS	4.7E-06	LA-140	80.
BA-141D	1.80E+01 MIN	1.7E-02	LA-141	93.
BA-142D	1.10E+01 MIN	7.4E-02	LA-142	100.
LA-140	1.67E+00 DYS	7.8E-06		
LA-141+D	3.90E+00 HRS	1.4E-03	CE-141	8.
LA-142	1.40E+00 HRS	1.1E-02		
CE-141	3.25E+01 DYS	8.9E-05		
CE-143+D	1.37E+00 DYS	3.[illegible]E-05	PR-143	41.
CE-144+D	2.85E+02 DYS	1.3E-05	PR-144	96.
PR-143	1.37E+01 DYS	4.9E-06		
PR-144	1.73E+01 MIN	4.6E+06		
ND-147	1.11E+01 DYS	3.8E-05		
PM-147	2.60E+00 YRS	9.9E-04		
W--187	2.40E+01 HRS	5.1E-05		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	1.6E-03		
AC-227	2.16E+01 YRS	5.1E-04		
TH-227+D	1.82E+01 DYS	1.0E+07	RA-223	12.
PA-231D	3.25E+04 YRS	1.6E+01	AC-227	100.
U--235	7.10E+08 YRS	1.[illegible]E+07		
NP-239D	2.35E+00 DYS	2.3E+06	PU-239	100.
PU-239	2.44E+04 YRS	3.0E-01		

BASED ON: EXTERNAL EXPOSURE TO BURIED WASTE
A MAXIMUM DOSE COMMITMENT OF 1.00 MREM/YR
EXPOSURE TIME = 1.0E+02 HOURS
DECAY TIME FROM BURIAL TO EXPOSURE = 1.0E-03 YEARS
WASTE DENSITY = 1.0 GM/CC
FRACTION OF SOIL WHICH IS WASTE = 1.0E+00

TABLE 48

CASE I-J -- SANITARY LANDFILL -
GROUND SURFACE EXPOSURE TO WORKERS AFTER 0.01 YR

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	1.0E+07		
C---14	5.73E+03 YRS	1.8E-03		
NA--24	1.50E+01 HRS	4.6E-04		
P---32	1.43E+01 DYS	5.8E-05		
CR--51	2.78E+01 DYS	2.0E-04		
MN--54	3.12E+02 DYS	8.8E-06		
MN--56	2.58E+00 HRS	1.7E+06		
FE--55	2.40E+00 YRS	1.0E+07		
FE--59	4.50E+01 DYS	6.8E-06		
CO--58	7.10E+01 DYS	7.4E-06		
CO--60	5.24E+00 YRS	3.2E-06		
NI--59	8.01E+04 YRS	1.0E+07		
NI--63	9.21E+01 YRS	1.0E+07		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	1.7E-02		
ZN--65	2.43E+02 DYS	1.3E-05		
ZN--69	5.50E+01 MIN	1.0E+07		
BR--83+D	2.40E+00 HRS	1.0E+07	KR-83M	10.
BR--84	3.20E+01 MIN	1.0E+07		
BR--85D	3.[illegible]E+00 MIN	2.1E+02	KR--85	100.
RB--86	1.87E+01 DYS	2.9E-05		
RB--88	1.80E+01 MIN	1. E+07		
RB--89D	1.50E+01 MIN	2.1E-01	SR--89	100.
SR--89	5.[illegible]6E+01 DYS	4.2E-05		
SR--90+D	2.88E+01 YRS	2.4E-05	Y---90	87.
SR--91+D	9.70E+00 HRS	5.4E-03	Y---91	71.
SR--92D	2.70E+00 HRS	1.6E+03	Y---92	100.
Y---90	2.67E+00 DYS	8.9E-05		
Y--91MD	5.00E+01 MIN	9.0E-02	Y---91	100.
Y---91	5.90E+01 DYS	5.2E-05		
Y---92	3.55E+00 HRS	5.0E+03		
Y---93	1.02E+01 HRS	3.1E-02		
ZR--93+D	1.5[illegible]E+06 YRS	2.[illegible]E-02	NB-93M	30.
ZR--95+D	6.50E+01 DYS	8.4E-06	NB--95	10.
ZR--97+D	1.70E+01 HRS	5.0E-04	NB--97	47.
NB-93M	3.70E+00 YRS	1.3E-04		
NB--95	3.50E+01 DYS	9.7E-06		
NB--97	1.20E+00 HRS	1.0E+07		
MO--99+D	2.79E+00 DYS	7.8E-05	TC-99M	27.
TC-99M	6.[illegible]E+00 HRS	2.0E+01		
TC--99	2.10E+05 YRS	5.7E-04		
RU-103	4.00E+01 DYS	1.3E-05		
RU-105D	4.43E+00 HRS	4.5E-03	RH-105	100.
RU-106D	1.[illegible]0E+00 YRS	9.0E-06	RH-106	100.
RH-105	1.50E+00 DYS	6.4E-04		
AG110M	2.60E+02 DYS	2.7E-06		
TE125M	5.80E+01 DYS	2.0E-03		
TE127MD	1.05E+02 DYS	1.3E-04	TE-127	100.
TE-127	9.30E+00 HRS	6.2E-01		
TE129M+D	3.40E+01 DYS	2.5E-05	TE-129	83.

TABLE 48

CASE I-J -- SANITARY LANDFILL -
GROUND SURFACE EXPOSURE TO WORKERS AFTER 0.01 YR

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129D	1.12E+00 HRS	1.0E+07	I--129	100.
TE131M+D	1.20E+00 DYS	6.6E-05	I--131	42.
TE-131D	2.50E+01 MIN	1.2E-02	I--131	100.
TE-132+D	3.25E+00 DYS	7.7E-06	I--132	92.
I--129	1.60E+07 YRS	1.1E-03		
I--130	1.24E+01 HRS	2.1E-03		
I--131	8.05E+00 DYS	2.5E-05		
I--132	2.30E+00 HRS	1.0E+07		
I--133+D	2.10E+01 HRS	4.8E-04	XE-133	22.
I--134	5.30E+01 MIN	1.0E+07		
I--135+D	6.70E+00 HRS	4.1E-02	XE-135	87.
CS-134	2.10E+00 YRS	3.8E-06		
CS-135	2.[illegible]0E+06 YRS	1.2E-03		
CS-136	1.30E+01 DYS	4.5E-06		
CS-137+D	3.[illegible]0E+01 YRS	9.1E-06	BA137M	95.
CS-138	3.22E+01 MIN	1.0E+07		
BA-140+D	1.28E+01 DYS	3.8E-06	LA-140	86.
BA-141D	1.80E+01 MIN	2.5E-01	CE-141	100.
BA-142D	1.10E+01 MIN	1.0E+07	LA-142	100.
LA-140	1.67E+00 DYS	3.0E-05		
LA-141D	3.90E+0[illegible] HRS	1.9E-02	CE-141	100.
LA-142	1.40E+00 HRS	1.0E+07		
CE-141	3.25E+01 DYS	9.6E-05		
CE-143+D	1.37E+00 DYS	4.7E-05	PR-143	82.
CE-144+D	2.85E+02 DYS	1.3E-05	PR-144	96.
PR-143	1.37E+01 DYS	5.8E-06		
PR-144	1.73E+01 MIN	1.0E+07		
ND-147	1.11E+01 DYS	4.6E-05		
PM-147	2.60E+00 YRS	9.9E-04		
W--187	2.40E+01 HRS	5.0E-04		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	1.6E-03		
AC-227	2.16E+01 YRS	5.1E-04		
TH-227+D	1.82E+01 DYS	1.0E+07	RA-223	24.
PA-231D	3.25E+04 YRS	1.6E+00	AC-227	100.
U--235	7.10E+08 YRS	1.0E+07		
NP-239D	2.35E+00 DYS	1.4E+06	PU-239	100.
PU-239	2.44E+04 YRS	3.0E-01		

BASED ON: EXTERNAL EXPOSURE TO BURIED WASTE
A MAXIMUM DOSE COMMITMENT OF 1.00 MREM/YR
EXPOSURE TIME = 1.0E+02 HOURS
DECAY TIME FROM BURIAL TO EXPOSURE = 1.0E-02 YEARS
WASTE DENSITY = 1.0 GM/CC
FRACTION OF SOIL WHICH IS WASTE = 1.0E+00

TABLE 52

CASE I-K -- SANITARY LANDFILL -
GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 5 YRS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H---3	1.23E+01 YRS	1.0E+07		
C---14	5.73E+03 YRS	2.6E-04		
NA--24	1.50E+01 HRS	1.0E+07		
P---32	1.43E+01 DYS	1.0E+07		
CR--51	2.78E+01 DYS	1.0E+07		
MN--54	3.12E+02 DYS	9.7E-05		
MN--56	2.58E+00 HRS	1.0E+07		
FE--55	2.4[illegible]E+00 YRS	1.0E+07		
FE--59	4.50E+01 DYS	6.6E+06		
CO--58	7.10E+01 DYS	1.7E+02		
CO--60	5.24E+00 YRS	9.3E-07		
NI--59	8.00E+04 YRS	1.0E+07		
NI--63	9.21E+01 YRS	1.0E+07		
NI--65	2.56E+00 HRS	1.[illegible]E+07		
CU--64	1.29E+01 HRS	1.0E+07		
ZN--65	2.43E+02 DYS	4.7E-04		
ZN--69	5.50E+01 MIN	1.0E+07		
BR--83	2.4[illegible]E+00 HRS	1.[illegible]E+07		
BR--84	3.2[illegible]E+01 MIN	1.0E+07		
BR--85D	3.00E+00 MIN	4.2E+01	KR--85	100.
RB--86	1.87E+01 DYS	1.0E+07		
RB--88	1.8[illegible]E+01 MIN	1.[illegible]E+07		
SR--89D	1.50E+01 MIN	1.0E+07	SR--89	100.
SR--89	5.[illegible]6E+01 DYS	1.6E+06		
SR--90+D	2.88E+01 YRS	3.1E-06	Y---90	90.
SR--91D	9.70E+00 HRS	7.4E+06	Y---91	100.
SR--92	2.70E+00 HRS	1.0E+07		
Y---90	2.67E+00 DYS	1.0E+07		
Y--91MD	5.00E+01 MIN	1.0E+07	Y---91	100.
Y---91	5.90E+01 DYS	5.1E+04		
Y---92	3.53E+00 HRS	1.[illegible]E+07		
Y---93D	1.02E+01 HRS	4.1E+04	NB-93M	99.
ZR--93+D	1.50E+06 YRS	3.2E-05	NB-93M	99.
ZR--95+D	6.50E+01 DYS	3.6E+02	NB--95	69.
ZR--97	1.70E+01 HRS	1.0E+07		
NB-93M	3.70E+01 YRS	5.3E-05		
NB--95	3.50E+01 DYS	1.0E+07		
NB--97	1.20E+00 HRS	1.0E+07		
MO--99D	2.79E+00 DYS	2.2E+03	TC--99	1[illegible]0.
TC-99MD	6.00E+00 HRS	2.5E+04	TC--99	100.
TC--99	2.10E+05 YRS	8.1E-05		
RU-103	4.00E+01 DYS	1.0E+07		
RU-105	4.43E+00 HRS	1.0E+07		
RU-106D	1.00E+00 YRS	5.3E-05	RH-106	100.
RH-105	1.50E+00 DYS	1.0E+07		
AG110M	2.60E+02 DYS	7.2E-05		
TE125M	5.80E+01 DYS	2.9E+06		
TE127MD	1.05E+02 DYS	6.[illegible]E+0[illegible]	TE-127	100.
TE-127	9.30E+00 HRS	[illegible].0E+07		
TE129MD	3.40E+01 DYS	2.6E+04	I--129	100.

TABLE 52

CASE I-K -- SANITARY LANDFILL -

GROUND SURFACE EXPOSURE TO RESIDENTS AFTER 5 YRS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129D	1.12E+00 HRS	1.0E+07	I--129	100.
TE131MD	1.20E+00 DYS	1.0E+07	XE131M	100.
TE-131D	2.50E+01 MIN	1.0E+07	XE131M	100.
TE-132+D	3.25E+00 DYS	1.0E+07	I--132	92.
I--129	1.60E+07 YRS	1.5E-04		
I--130	1.24E+01 HRS	1.0E+07		
I--131D	8.05E+00 DYS	1.0E+07	XE131M	100.
I--132	2.30E+00 HRS	1.0E+07		
I--133D	2.10E+01 HRS	1.0E+07	XE-133	100.
I--134	5.30E+01 MIN	1.0E+07		
I--135D	6.70E+00 HRS	4.5E+05	CS-135	100.
CS-134	2.10E+00 YRS	3.2E-06		
CS-135	2.00E+06 YRS	1.7E-04		
CS-136	1.30E+01 DYS	1.0E+07		
CS-137+D	3.00E+01 YRS	1.5E-06	BA137M	95.
CS-138	3.22E+01 MIN	1.0E+07		
BA-140+D	1.28E+01 DYS	1.0E+07	LA-140	88.
BA-141D	1.80E+01 MIN	1.0E+07	CE-141	100.
BA-142	1.10E+01 MIN	1.0E+07		
LA-140	1.67E+00 DYS	1.0E+07		
LA-141D	3.90E+00 HRS	1.0E+07	CE-141	100.
LA-142	1.40E+00 HRS	1.0E+07		
CE-141	3.25E+01 DYS	1.0E+07		
CE-143D	1.37E+00 DYS	1.0E+07	PR-143	100.
CE-144+D	2.85E+02 DYS	2.2E-04	PR-144	96.
PR-143	1.37E+01 DYS	1.0E+07		
PR-144	1.73E+01 MIN	1.0E+07		
ND-147D	1.11E+01 DYS	5.0E-02	PM-147	100.
PM-147	2.60E+00 YRS	5.9E-04		
W--187	2.40E+01 HRS	1.0E+07		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	2.3E-04		
AC-227	2.16E+01 YRS	8.7E-05		
TH-227+D	1.82E+01 DYS	1.0E+07	RA-223	73.
PA-231D	3.25E+04 YRS	4.6E-04	AC-227	100.
U--235	7.10E+08 YRS	1.0E+07		
NP-239D	2.35E+00 DYS	1.6E+05	PU-239	100.
PU-239	2.44E+04 YRS	4.2E-02		

BASED ON: EXTERNAL EXPOSURE TO BURIED WASTE
A MAXIMUM DOSE COMMITMENT OF 1.00 MREM/YR
EXPOSURE TIME = 7.0E+03 HOURS
DECAY TIME FROM BURIAL TO EXPOSURE = 5.0E+00 YEARS
WASTE DENSITY = 1.0 GM/CC
FRACTION OF SOIL WHICH IS WASTE = 1.0E-01

TABLE 76

CASE II-K -- FILL WANTED -
GROUND SURFACE EXPOSURE TO RESIDENTS AFTER NO DECAY

ISOTOPE	HALF-LIFE		LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01	YRS	1.0E+07		
C---14	5.73E+03	YRS	4.6E-04		
NA--24	1.50E+01	HRS	4.0E-05		
P---32	1.43E+01	DYS	4.5E-05		
CR--51	2.78E+01	DYS	1.0E-04		
MN--54	3.12E+02	DYS	2.4E-06		
MN--56	2.58E+00	HRS	5.0E-04		
FE--55	2.40E+00	YRS	1.0E+07		
FE--59	4.50E+01	DYS	2.8E-06		
CO--58	7.10E+01	DYS	2.6E-06		
CO--60	5.24E+00	YRS	8.[illegible]E-07		
NI--59	8.01E+04	YRS	1.0E+07		
NI--63	9.21E+01	YRS	1.0E+07		
NI--65	2.56E+00	HRS	1.0E+07		
CU--64	1.29E+01	HRS	7.5E-04		
ZN--65	2.43E+02	DYS	3.5E-06		
ZN--69	5.50E+01	MIN	3.1E-02		
BR--83+D	2.40E+00	HRS	1.2E-02	KR-83M	2.
BR--84	3.20E+01	MIN	1.8E-03		
BR--85+D	3.00E+00	MIN	8.4E-02	KR-85M	34.
RB--86	1.87E+01	DYS	1.9E-05		
RB--88	1.80E+01	MIN	5.6E-03		
RB--89+D	1.50E+01	MIN	3.[illegible]E-03	SR--89	5.
SR--89	5.06E+01	DYS	1.6E-05		
SR--90+D	2.88E+01	YRS	4.9E-06	Y---90	89.
SR--91+D	9.70E+00	HRS	1.7E-04	Y--91M	30.
SR--92+D	2.70E+00	HRS	4.1E-04	Y---92	36.
Y---90	2.67E+00	DYS	1.1E-04		
Y--91M+D	5.00E+01	MIN	3.6E-02	Y---91	11.
Y---91	5.90E+01	DYS	1.8E-05		
Y---92	3.53E+00	HRS	8.5E-04		
Y---93	1.02E+01	HRS	4.0E-04		
ZR--93+D	1.50E+06	YRS	1.4E-03	NB-93M	83.
ZR--95+D	6.50E+01	DYS	2.1E-06	NB--95	35.
ZR--97+D	1.70E+01	HRS	7.1E-05	NB--97	45.
NB-93M	3.70E+00	YRS	3.4E-05		
NB--95	3.50E+01	DYS	4.4E-06		
NB--97	1.20E+00	HRS	2.2E-03		
MO--99+D	2.79E+00	DYS	1.0E-04	TC-99M	26.
TC-99M	6.00E+00	HRS	4.1E-03		
TC--99	2.10E+05	YRS	1.4E-04		
RU-103	4.00E+01	DYS	5.6E-06		
RU-105+D	4.43E+00	HRS	5.4E-04	RH-105	13.
RU-106D	1.00E+00	YRS	2.4E-06	RH-106	100.
RH-105	1.50E+00	DYS	5.0E-04		
AG110M	2.60E+02	DYS	7.5E-07		
TE125M	5.80E+01	DYS	7.4E-04		
TE127MD	1.05E+02	DYS	4.0E-05	TE-127	100.
TE-127	9.35E+00	HRS	4.5E-03		
TE129M+D	3.40E+01	DYS	1.1E-05	TE-129	82.

TABLE 76

CASE II-K -- FILL WANTED -
GROUND SURFACE EXPOSURE TO RESIDENTS AFTER NO DECAY

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	1.0E+07		
C---14	5.73E+03 YRS	4.5E-04		
NA--24	1.50E+01 HRS	4.0E-05		
P---32	1.43E+01 DYS	4.5E-05		
CR--51	2.78E+01 DYS	1.0E-04		
MN--54	3.12E+02 DYS	2.4E-06		
MN--56	2.58E+00 HRS	5.0E-04		
FE--55	2.40E+00 YRS	1.0E+07		
FE--59	4.50E+01 DYS	2.8E-06		
CO--58	7.10E+01 DYS	2.6E-06		
CO--60	5.24E+00 YRS	8.[illegible]E-07		
NI--59	8.01E+04 YRS	1.0E+07		
NI--63	9.21E+01 YRS	1.0E+07		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.28E+01 HRS	7.5E-04		
ZN--65	2.43E+02 DYS	3.5E-06		
ZN--69	5.50E+01 MIN	3.1E-02		
BR--83+D	2.40E+00 HRS	1.2E-02	KR-83M	2.
BR--84	3.20E+01 MIN	1.8E-03		
BR--85+D	3.00E+00 MIN	8.4E-02	KR-85M	34.
RB--86	1.87E+01 DYS	1.9E-05		
RB--88	1.80E+01 MIN	5.6E-03		
RB--89+D	1.50E+01 MIN	3.4E-03	SR--89	5.
SR--89	5.06E+01 DYS	1.6E-05		
SR--90+D	2.88E+01 YRS	4.9E-06	Y---90	89.
SR--91+D	9.70E+00 HRS	1.7E-04	Y--91M	30.
SR--92+D	2.70E+00 HRS	4.1E-04	Y---92	36.
Y---90	2.67E+00 DYS	1.1E-04		
Y--91M+D	5.00E+01 MIN	3.6E-03	Y---91	11.
Y---91	5.90E+01 DYS	1.4E-05		
Y---92	3.53E+00 HRS	8.5E-04		
Y---93	1.02E+01 HRS	4.0E-04		
ZR--93+D	1.50E+06 YRS	1.4E-03	NB-93M	83.
ZR--95+D	6.50E+01 DYS	2.1E-06	NB--95	36.
ZR--97+D	1.70E+01 HRS	7.1E-05	NB--97	45.
NB-93M	3.70E+00 YRS	3.4E-05		
NB--95	3.50E+01 DYS	4.4E-06		
NB--97	1.20E+00 HRS	2.2E-03		
MO--99+D	2.79E+00 DYS	1.0E-04	TC-99M	26.
TC-99M	6.00E+00 HRS	4.1E-03		
TC--99	2.10E+05 YRS	1.4E-04		
RU-103	4.00E+01 DYS	5.6E-06		
RU-105+D	4.43E+00 HRS	5.4E-04	RH-105	13.
RU-106D	1.00E+00 YRS	2.4E-06	RH-106	[illegible]
RH-105	1.50E+00 DYS	5.0E-04		
AG110M	2.60E+02 DYS	7.5E-07		
TE125M	5.80E+01 DYS	7.4E-04		
TE127MD	1.[illegible]5E+02 DYS	4.0E-05	TE-127	100.
TE-127	9.30E+00 HRS	4.5E-03		
TE129M+D	3.40E+01 DYS	1.1E-05	TE-129	82.

TABLE 96

CASE III-C -- SANITARY LANDFILL -
INHALATION SPILLED WASTE AFTER NO DECAY

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	1.1E+06		
C---14	5.73E+03 YRS	6.6E+04		
NA--24	1.50E+01 HRS	8.9E+04		
P---32	1.43E+01 DYS	9.1E+02		
CR--51	2.78E+01 DYS	8.3E+04		
MN--54	3.12E+02 DYS	8.6E+02		
MN--56	2.58E+00 HRS	5.9E+04		
FE--55	2.40E+00 YRS	1.5E+03		
FE--59	4.50E+01 DYS	4.3E+01		
CO--58	7.10E+01 DYS	1.3E+03		
CO--60	5.24E+00 YRS	2.0E+02		
NI--59	8.01E+04 YRS	1.8E+04		
NI--63	9.21E+01 YRS	2.8E+03		
NI--65	2.56E+00 HRS	9.[illegible]E+04		
CU--64	1.29E+01 HRS	2.5E+04		
ZN--65	2.43E+02 DYS	1.4E+03		
ZN--69	5.50E+01 MIN	1.3E+06		
BR--83	2.40E+00 HRS	5.0E+06		
BR--84	3.20E+01 MIN	3.3E+06		
BR--85	3.00E+00 MIN	1.0E+07		
RB--86	1.87E+01 DYS	8.9E+03		
RB--88	1.80E+01 MIN	3.1E+06		
RB--89	1.50E+01 MIN	4.7E+06		
SR--89	5.06E+01 DYS	8.6E+02		
SR--90	2.88E+01 YRS	1.2E+01		
SR--91	9.70E+00 HRS	5.3E+03		
SR--92	2.70E+00 HRS	2.8E+04		
Y---90	2.67E+00 DYS	2.4E+03		
Y--91M	5.[illegible]E+01 MIN	6.2E+05		
Y---91	5.90E+01 DYS	7.0E+02		
Y---92	3.53E+00 HRS	1.6E+04		
Y---93	1.02E+01 HRS	2.8E+03		
ZR--93	1.5[illegible]E+06 YRS	2.9E+03		
ZR--95	6.50E+01 DYS	6.9E+02		
ZR--97	1.70E+01 HRS	2.3E+03		
NB-93M	3.70E+00 YRS	4.[illegible]E+03		
NB--95	3.50E+01 DYS	2.4E+03		
NB--97	1.20E+00 HRS	5.0E+05		
MO--99	2.79E+00 DYS	4.8E+03		
TC-99M	6.[illegible]E+00 HRS	2.9E+05		
TC--99	2.10E+05 YRS	1.1E+03		
RU-103	4.00E+01 DYS	2.4E+03		
RU-105	4.43E+00 HRS	2.5E+04		
RU-106	1.00E+00 YRS	1.3E+02		
RH-105	1.50E+00 DYS	1.4E+04		
AG110M	2.60E+02 DYS	2.6E+02		
TE125M	5.80E+01 DYS	3.8E+03		
TE127M	1.05E+02 DYS	1.3E+03		
TE-127	9.30E+00 HRS	2.1E+04		
TE129M	3.40E+01 DYS	1.0E+03		

TABLE 96

CASE III-C -- SANITARY LANDFILL -
INHALATION SPILLED WASTE AFTER NO DECAY

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129	1.12E+00 HRS	6.2E+05		
TE131M	1.20E+00 DYS	2.2E+03		
TE-131	2.50E+01 MIN	8.6E+05		
TE-132	3.25E+00 DYS	2.4E+03		
I--129	1.60E+07 YRS	2.7E+01		
I--130	1.24E+01 HRS	6.9E+02		
I--131	8.05E+00 DYS	1.0E+02		
I--132	2.30E+00 HRS	2.7E+03		
I--133	2.10E+01 HRS	4.1E+02		
I--134	5.30E+01 MIN	5.2E+03		
I--135	6.70E+00 HRS	1.3E+03		
CS-134	2.10E+00 YRS	1.4E+03		
CS-135	2.00E+06 YRS	1.0E+04		
CS-136	1.30E+01 DYS	8.0E+03		
CS-137	3.00E+01 YRS	1.9E+03		
CS-138	3.20E+01 MIN	1.[illegible]E+06		
BA-140	1.28E+01 DYS	9.4E+02		
BA-141	1.80E+01 MIN	6.2E+05		
BA-142	1.10E+01 MIN	1.0E+06		
LA-140	1.67E+00 DYS	2.6E+03		
LA-141	3.90E+00 HRS	2.1E+04		
LA-142	1.40E+00 HRS	1.[illegible]E+05		
CE-141	3.25E+01 DYS	3.3E+03		
CE-143	1.37E+00 DYS	5.3E+03		
CE-144	2.85E+02 DYS	1.5E+02		
PR-143	1.37E+01 DYS	4.3E+03		
PR-144	1.73E+01 MIN	1.2E+06		
ND-147	1.11E+01 DYS	5.4E+03		
PM-147	2.60E+00 YRS	1.8E+03		
W--187	2.40E+01 HRS	7.7E+03		
RA-223	1.14E+01 DYS	5.9E+[illegible]		
RA-226	1.60E+03 YRS	1.2E+00		
AC-227	2.16E+01 YRS	6.5E-02		
TH-227	1.82E+01 DYS	4.0E+00		
PA-231	3.25E+04 YRS	3.0E-02		
U--235	7.10E+08 YRS	3.1E+00		
NP-239	2.35E+00 DYS	1.0E+04		
PU-239	2.44E+04 YRS	4.9E-02		

BASED ON: INHALATION OF WASTE SPILLED DURING DISPOSAL
A MAXIMUM DOSE COMMITMENT OF 3.00 MREM/YR TO ADULTS
WASTE CONCENTRATION IN AIR = 2.0E-02 MICROGRAMS PER CUBIC METER
EXPOSURE TIME = 1.0E+03 HOURS/YEAR
BREATHING RATE = 1.0 CUBIC METERS PER HOUR
DECAY TIME FROM SPILLAGE TO EXPOSURE = 0. YEARS
FRACTION OF MATERIAL INHALED WHICH IS WASTE = 1.000

TABLE 104

CASE III-D -- SANITARY LANDFILL -
INHALATION DURING SITE EXCAVATION AFTER 5 YRS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	1.5E+03		
C---14	5.73E+03 YRS	6.6E+0[illegible]		
NA--24	1.50E+01 HRS	1.0E+07		
P---32	1.43E+01 DYS	1.0E+07		
CR--51	2.78E+01 DYS	1.0E+07		
MN--54	3.12E+02 DYS	4.9E+01		
MN--56	2.58E+00 HRS	1.0E+07		
FE--55	2.40E+00 YRS	6.4E+0[illegible]		
FE--59	4.50E+01 DYS	1.0E+07		
CO--58	7.10E+01 DYS	1.0E+07		
CO--60	5.24E+00 YRS	3.9E-01		
NI--59	8.[illegible]1E+04 YRS	1.9E+01		
NI--63	9.21E+01 YRS	2.9E+0[illegible]		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	1.0E+07		
ZN--65	2.43E+02 DYS	2.5E+02		
ZN--69	5.5[illegible]E+01 MIN	1.0E+07		
BR--83	2.40E+00 HRS	1.0E+07		
BR--84	3.20E+01 MIN	1.0E+07		
BR--85	3.00E+00 MIN	1.0E+07		
RB--86	1.87E+01 DYS	1.0E+07		
RB--88	1.80E+01 MIN	1.0E+07		
RB--89D	1.50E+01 MIN	1.0E+07	SR--89	100.
SR--89	5.[illegible]5E+01 DYS	1.0E+07		
SR--90	2.89E+01 YRS	1.4E-02		
SR--91D	9.70E+00 HRS	1.0E+07	Y---91	100.
SR--92	2.70E+00 HRS	1.0E+07		
Y---90	2.67E+00 DYS	1.0E+07		
Y--91MD	5.[illegible]E+01 MIN	1.0E+07	Y---91	100.
Y---91	5.90E+01 DYS	1.[illegible]E+07		
Y---92	3.53E+00 HRS	1.0E+07		
Y---93D	1.02E+01 HRS	1.0E+07	ZR--93	74.
ZR--93+D	1.50E+06 YRS	2.1E+00	NB-93M	26.
ZR--95+D	6.50E+01 DYS	1.[illegible]E+07	NB--95	38.
ZR--97	1.70E+01 HRS	1.0E+07		
NB-93M	3.7[illegible]E+0[illegible] YRS	1.2E+01		
NB--95	3.50E+01 DYS	1.0E+07		
NB--97	1.2[illegible]E+0[illegible] HRS	1.0E+07		
MO--99D	2.79E+00 DYS	1.0E+07	TC--99	100.
TC-99MD	6.[illegible]E+00 HRS	1.0E+07	TC--99	100.
TC--99	2.10E+05 YRS	1.1E+00		
RU-103	4.[illegible]E+01 DYS	1.0E+07		
RU-105	4.43E+00 HRS	1.0E+07		
RU-106	1.00E+00 YRS	4.1E+0[illegible]		
RH-105	1.50E+00 DYS	1.0E+07		
AG110M	2.60E+02 DYS	3.4E+01		
TE125M	5.80E+01 DYS	1.0E+07		
TE127M+D	1.[illegible]5E+02 DYS	2.[illegible]E+05	TE-127	6.
TE-127	9.30E+00 HRS	1.0E+07		
TE129MD	3.40E+01 DYS	4.6E+06	I--129	100.

TABLE 104

CASE III-D -- SANITARY LANDFILL -
INHALATION DURING SITE EXCAVATION AFTER 5 YRS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129D	1.12E+00 HRS	1.0E+07	I--129	100.
TE131MD	1.20E+00 DYS	1.0E+07	I--131	100.
TE-131D	2.50E+01 MIN	1.0E+07	I--131	100.
TE-132+D	3.25E+00 DYS	1.0E+07	I--132	47.
I--129	1.60E+07 YRS	2.7E-02		
I--130	1.24E+01 HRS	1.0E+07		
I--131	8.05E+00 DYS	1.0E+07		
I--132	2.30E+00 HRS	1.0E+07		
I--133	2.10E+01 HRS	1.0E+07		
I--134	5.30E+01 MIN	1.0E+07		
I--135D	6.70E+00 HRS	1.0E+07	CS-135	100.
CS-134	2.10E+00 YRS	7.4E+00		
CS-135	2.00E+06 YRS	1.[illegible]E+01		
CS-136	1.30E+01 DYS	1.0E+07		
CS-137	3.[illegible]E+01 YRS	2.2E+00		
CS-138	3.22E+01 MIN	1.0E+07		
BA-140+D	1.28E+01 DYS	1.0E+07	LA-140	29.
BA-141D	1.80E+01 MIN	1.0E+07	CE-141	100.
BA-142	1.10E+01 MIN	1.0E+07		
LA-140	1.67E+00 DYS	1.0E+07		
LA-141D	3.90E+00 HRS	1.0E+07	CE-141	100.
LA-142	1.40E+00 HRS	1.0E+07		
CE-141	3.25E+01 DYS	1.0E+07		
CE-143D	1.37E+00 DYS	1.0E+07	PR-143	100.
CE-144	2.85E+02 DYS	1.3E+01		
PR-143	1.37E+01 DYS	1.0E+07		
PR-144	1.73E+01 MIN	1.0E+07		
ND-147D	1.11E+01 DYS	5.7E+02	PM-147	100.
PM-147	2.60E+00 YRS	6.8E+00		
W--187	2.40E+01 HRS	1.0E+07		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	1.2E-03		
AC-227+D	2.16E+01 YRS	7.5E-05	TH-227	2.
TH-227+D	1.82E+01 DYS	1.0E+07	RA-223	64.
PA-231+D	3.25E+04 YRS	2.8E-05	AC-227	6.
U--235	7.10E+08 YRS	3.1E-03		
NP-239D	2.35E+00 DYS	1.9E+02	PU-239	100.
PU-239	2.44E+04 YRS	4.9E-05		

BASED ON: INHALATION OF AIRBORNE WASTE BY INTRUDER
A MAXIMUM DOSE COMMITMENT OF 3.00 MREM/YR TO ADULTS
WASTE CONCENTRATION IN AIR = 1.0 MG PER CUBIC METER
EXPOSURE TIME = 1.0E+02 HOURS
BREATHING RATE = 1.0 CUBIC METERS PER HOUR
DECAY TIME FROM BURIAL TO EXPOSURE = 5.0E+00 YEARS
FRACTION OF MATERIAL INHALED WHICH IS WASTE = .200

TABLE 112

CASE III-F -- SANITARY LANDFILL -
FOOD GROWN ON WASTE SITE AFTER 5 YEARS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	2.0E-04		
C---14	5.73E+03 YRS	5.4E-06		
NA--24	1.50E+01 HRS	1.0E+07		
P---32	1.43E+01 DYS	1.0E+07		
CR--51	2.78E+01 DYS	1.0E+07		
MN--54	3.12E+02 DYS	2.8E-02		
MN--56	2.58E+00 HRS	1.0E+07		
FE--55	2.40E+00 YRS	3.1E-02		
FE--59	4.50E+01 DYS	1.0E+07		
CO--58	7.10E+01 DYS	6.7E+04		
CO--60	5.24E+00 YRS	8.9E-04		
NI--59	8.01E+04 YRS	6.3E-04		
NI--63	9.21E+01 YRS	4.9E-05		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	1.0E+07		
ZN--65	2.43E+02 DYS	1.2E-03		
ZN--69	5.50E+01 MIN	1.0E+07		
BR--83	2.40E+00 HRS	1.0E+07		
BR--84	3.20E+01 MIN	1.0E+07		
BR--85	3.00E+00 MIN	1.0E+07		
RB--86	1.87E+01 DYS	1.0E+07		
RB--88	1.80E+01 MIN	1.0E+07		
RB--89D	1.50E+01 MIN	1.0E+07	SR--89	100.
SR--89	5.06E+01 DYS	2.5E+06		
SR--90	2.88E+01 YRS	1.6E-06		
SR--91D	9.70E+00 HRS	1.0E+07	Y---91	100.
SR--92	2.70E+00 HRS	1.0E+07		
Y---90	2.67E+00 DYS	1.0E+07		
Y--91MD	5.00E+01 MIN	1.0E+07	Y---91	100.
Y---91	5.90E+01 DYS	2.0E+06		
Y---92	3.53E+00 HRS	1.0E+07		
Y---93D	1.02E+01 HRS	5.4E+06	NB-93M	99.
ZR--93+D	1.50E+06 YRS	4.2E-03	NB-93M	99.
ZR--95+D	6.50E+01 DYS	5.3E+04	NB--95	99.
ZR--97	1.70E+01 HRS	1.0E+07		
NB-93M	3.7[illegible]E+[illegible] YRS	6.2E-03		
NB--95	3.50E+01 DYS	1.0E+07		
NB--97	1.20E+00 HRS	1.0E+07		
MO--99D	2.79E+00 DYS	7.2E+02	TC--99	1[illegible].
TC-99MD	6.00E+00 HRS	8.0E+03	TC--99	100.
TC--99	2.10E+05 YRS	2.6E-05		
RU-103	4.[illegible]E+01 DYS	1.0E+07		
RU-105	4.43E+00 HRS	1.0E+07		
RU-106	1.00E+00 YRS	2.9E-04		
RH-105	1.50E+00 DYS	1.0E+07		
AG110M	2.60E+02 DYS	4.6E-04		
TE125M	5.80E+01 DYS	3.0E+04		
TE127M+D	1.05E+02 DYS	5.3E-01	TE-127	24.
TE-127	9.30E+00 HRS	1.0E+07		
TE129MD	3.40E+01 DYS	1.5E+02	I--129	100.

TABLE 112

CASE III-F -- SANITARY LANDFILL -
FOOD GROWN ON WASTE SITE AFTER 5 YEARS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129D	1.12E+00 HRS	1.1E+05	I--129	100.
TE131MD	1.20E+00 DYS	1.0E+07	I--131	100.
TE-131D	2.50E+01 MIN	1.0E+07	I--131	100.
TE-132+D	3.25E+00 DYS	1.0E+07	I--132	2.
I--129	1.60E+07 YRS	8.5E-07		
I--130	1.24E+01 HRS	1.0E+07		
I--131	8.05E+00 DYS	1.0E+07		
I--132	2.30E+00 HRS	1.0E+07		
I--133	2.10E+01 HRS	1.0E+07		
I--134	5.30E+01 MIN	1.0E+07		
I--135D	6.70E+00 HRS	1.2E+06	CS-135	100.
CS-134	2.10E+00 YRS	3.1E-04		
CS-135	2.00E+06 YRS	4.5E-04		
CS-136	1.30E+01 DYS	1.0E+07		
CS-137	3.00E+01 YRS	9.1E-05		
CS-138	3.22E+01 MIN	1.0E+07		
BA-140+D	1.28E+01 DYS	1.0E+07	LA-140	55.
BA-141D	1.80E+01 MIN	1.0E+07	CE-141	100.
BA-142	1.10E+01 MIN	1.0E+07		
LA-140	1.67E+00 DYS	1.0E+07		
LA-141D	3.90E+00 HRS	1.0E+07	CE-141	100.
LA-142	1.40E+00 HRS	1.0E+07		
CE-141	3.25E+01 DYS	1.0E+07		
CE-143D	1.37E+00 DYS	1.0E+07	PR-143	100.
CE-144	2.85E+02 DYS	3.8E-02		
PR-143	1.37E+01 DYS	1.0E+07		
PR-144	1.73E+01 MIN	1.0E+07		
ND-147D	1.11E+01 DYS	2.8E+00	PM-147	100.
PM-147	2.60E+00 YRS	3.3E-02		
W--187	2.40E+01 HRS	1.0E+07		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	1.1E-06		
AC-227+D	2.16E+01 YRS	2.1E-05	RA-223	27.
TH-227+D	1.82E+01 DYS	1.0E+07	RA-223	78.
PA-231+D	3.25E+04 YRS	1.3E-05	AC-227	6.
U--235	7.10E+08 YRS	9.5E-05		
NP-239D	2.35E+00 DYS	4.0E+03	PU-239	100.
PU-239	2.44E+04 YRS	1.1E-03		

BASED ON: CONSUMPTION OF FOOD GROWN ON WASTE SITE
A MAXIMUM DOSE COMMITMENT OF 3.00 MREM/YR TO ADULTS
DECAY TIME FROM BURIAL TO INGESTION = 5.0E+00 YEARS
CONSUMPTION OF 150. KG OF FRUITS AND VEGETABLES PER YEAR
CONSUMPTION OF 310. LITERS OF MILK PER YEAR
CONSUMPTION OF 11. KG OF MEAT PER YEAR
CONSUMPTION RATE OF COW = 50. KG/DAY
CONSUMPTION RATE OF CATTLE = 50. KG/DAY
FRACTION OF SOIL WHICH IS WASTE = .10

TABLE 114

CASE III-F -- SANITARY LANDFILL -
FOOD GROWN ON WASTE SITE AFTER 100 YEARS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	4.3E-02		
C---14	5.73E+03 YRS	5.5E-06		
NA--24	1.50E+01 HRS	1.0E+07		
P---32	1.43E+01 DYS	1.0E+07		
CR--51	2.78E+01 DYS	1.0E+07		
MN--54	3.12E+02 DYS	1.0E+07		
MN--56	2.58E+00 HRS	1.0E+07		
FE--55	2.40E+00 YRS	1.0E+07		
FE--59	4.50E+01 DYS	1.0E+07		
CO--58	7.10E+01 DYS	1.0E+07		
CO--60	5.24E+00 YRS	2.5E+02		
NI--59	8.00E+04 YRS	6.3E-04		
NI--63	9.21E+01 YRS	1.0E-04		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	1.0E+07		
ZN--65	2.43E+02 DYS	1.0E+07		
ZN--69	5.50E+01 MIN	1.0E+07		
BR--83	2.40E+00 HRS	1.0E+07		
BR--84	3.20E+01 MIN	1.0E+07		
BR--85	3.00E+00 MIN	1.0E+07		
RB--86	1.87E+01 DYS	1.0E+07		
RB--88	1.80E+01 MIN	1.0E+07		
KR--89D	1.50E+01 MIN	1.0E+07	SR--89	100.
SR--89	5.05E+01 DYS	1.0E+07		
SR--90	2.88E+01 YRS	1.6E-05		
SR--91D	9.70E+00 HRS	1.0E+07	Y---91	100.
SR--92	2.70E+00 HRS	1.0E+07		
Y---90	2.67E+00 DYS	1.0E+07		
Y--91MD	5.00E+01 MIN	1.0E+07	Y---91	100.
Y---91	5.90E+01 DYS	1.0E+07		
Y---92	3.53E+00 HRS	1.0E+07		
Y---93D	1.02E+01 HRS	3.3E+06	NB-93M	99.
ZR--93+D	1.50E+06 YRS	2.5E-03	NB-93M	99.
ZR--95+D	6.50E+01 DYS	1.0E+07	NB--95	99.
ZR--97	1.70E+01 HRS	1.0E+07		
NB-93M	3.70E+01 YRS	3.3E+05		
NB--95	3.50E+01 DYS	1.0E+07		
NB--97	1.20E+00 HRS	1.0E+07		
MO--99D	2.79E+00 DYS	7.2E+02	TC--99	100.
TC-99MD	6.00E+00 HRS	8.0E+03	TC--99	100.
TC--99	2.10E+05 YRS	2.6E-05		
RU-103	4.[illegible]E+01 DYS	1.0E+07		
RU-105	4.43E+00 HRS	1.0E+07		
RU-106	1.0[illegible]E+00 YRS	1.0E+07		
RH-105	1.50E+00 DYS	1.0E+07		
AG110M	2.50E+02 DYS	1.0E+07		
TE125M	5.80E+01 DYS	1.0E+07		
TE127M+D	1.[illegible]5E+02 DYS	1.0E+07	TE-127	24.
TE-127	9.30E+00 HRS	1.0E+07		
TE129MD	3.40E+01 DYS	1.5E+02	I--129	100.

TABLE 114

CASE III-F -- SANITARY LANDFILL -
FOOD GROWN ON WASTE SITE AFTER 100 YEARS

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129D	1.12E+00 HRS	1.1E+05	I--129	100.
TE131M	1.20E+00 DYS	1.0E+07		
TE-131	2.50E+01 MIN	1.0E+07		
TE-132	3.25E+00 DYS	1.0E+07		
I--129	1.60E+07 YRS	8.5E-07		
I--130	1.24E+01 HRS	1.0E+07		
I--131	8.05E+00 DYS	1.0E+07		
I--132	2.30E+00 HRS	1.0E+07		
I--133	2.10E+01 HRS	1.0E+07		
I--134	5.30E+01 MIN	1.0E+07		
I--135D	6.70E+00 HRS	1.2E+06	CS-135	100.
CS-134	2.10E+00 YRS	1.0E+07		
CS-135	2.00E+06 YRS	4.5E-04		
CS-136	1.30E+01 DYS	1.0E+07		
CS-137	3.00E+01 YRS	8.2E-04		
CS-138	3.22E+01 MIN	1.0E+07		
BA-140	1.28E+01 DYS	1.0E+07		
BA-141	1.80E+01 MIN	1.0E+07		
BA-142	1.10E+01 MIN	1.0E+07		
LA-140	1.67E+00 DYS	1.0E+07		
LA-141	3.90E+00 HRS	1.0E+07		
LA-142	1.40E+00 HRS	1.0E+07		
CE-141	3.25E+01 DYS	1.0E+07		
CE-143	1.37E+00 DYS	1.0E+07		
CE-144	2.85E+02 DYS	1.0E+07		
PR-143	1.37E+01 DYS	1.0E+07		
PR-144	1.73E+01 MIN	1.0E+07		
ND-147D	1.11E+01 DYS	1.0E+07	PM-1+7	100.
PM-147	2.60E+00 YRS	1.0E+07		
W--187	2.40E+01 HRS	1.0E+07		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	1.1E-06		
AC-227+D	2.16E+01 YRS	4.5E-04	RA-223	27.
TH-227	1.82E+01 DYS	1.0E+07		
PA-231+D	3.25E+04 YRS	8.4E-06	AC-227	23.
U--235	7.10E+08 YRS	9.5E-05		
NP-239D	2.35E+00 DYS	4.0E+03	PU-239	100.
PU-239	2.44E+04 YRS	1.1E-03		

BASED ON: CONSUMPTION OF FOOD GROWN ON WASTE SITE
A MAXIMUM DOSE COMMITMENT OF 3.00 MREM/YR TO ADULTS
DECAY TIME FROM BURIAL TO INGESTION = 1.0E+02 YEARS
CONSUMPTION OF 150. KG OF FRUITS AND VEGETABLES PER YEAR
CONSUMPTION OF 310. LITERS OF MILK PER YEAR
CONSUMPTION OF 11. KG OF MEAT PER YEAR
CONSUMPTION RATE OF COW = 50. KG/DAY
CONSUMPTION RATE OF CATTLE = 50. KG/DAY
FRACTION OF SOIL WHICH IS WASTE = .10

TABLE 129

CASE IV-F -- FILL WANTED DISPOSAL -
FOOD GROWN IN WASTE AFTER 0.5 YEARS DECAY

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	1.0E-04		
C---14	5.73E+03 YRS	3.7E-06		
NA--24	1.50E+01 HRS	1.0E+07		
P---32	1.43E+01 DYS	1.3E-03		
CR--51	2.78E+01 DYS	5.0E+01		
MN--54	3.12E+02 DYS	3.6E-04		
MN--56	2.58E+00 HRS	1.0E+07		
FE--55	2.40E+00 YRS	4.5E-03		
FE--59	4.50E+01 DYS	6.1E-02		
CO--58	7.10E+01 DYS	3.8E-03		
CO--60	5.24E+00 YRS	2.[illegible]E-04		
NI--59	8.01E+04 YRS	3.9E-04		
NI--63	9.21E+01 YRS	3.0E-05		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	1.0E+07		
ZN--65	2.43E+02 DYS	8.7E-06		
ZN--69	5.50E+01 MIN	1.0E+07		
BR--83	2.40E+00 HRS	1.0E+07		
BR--84	3.20E+01 MIN	1.0E+07		
BR--85	3.00E+00 MIN	1.0E+07		
RB--86	1.87E+01 DYS	1.2E-02		
RB--88	1.80E+01 MIN	1.0E+07		
RB--89D	1.50E+01 MIN	1.1E+00	SR--89	100.
SR--89	5.[illegible]6E+01 DYS	2.2E-04		
SR--90	2.88E+01 YRS	7.5E-07		
SR--91D	9.70E+00 HRS	6.1E-01	Y---91	100.
SR--92	2.70E+00 HRS	1.0E+07		
Y---90	2.67E+00 DYS	1.0E+07		
Y--91MD	5.00E+01 MIN	7.2E+00	Y---91	100.
Y---91	5.90E+01 DYS	4.2E-03		
Y---92	3.53E+00 HRS	1.0E+07		
Y---93D	1.[illegible]2E+01 HRS	1.0E+07	NB-93M	93.
ZR--93+D	1.50E+06 YRS	1.4E-02	NB-93M	93.
ZR--95+D	6.50E+01 DYS	9.3E-04	NB--95	99.
ZR--97+D	1.70E+01 HRS	1.0E+07	NB--97	5.
NB-93M	3.70E+00 YRS	1.4E-03		
NB--95	3.50E+01 DYS	8.7E-03		
NB--97	1.20E+00 HRS	1.0E+07		
MO--99D	2.79E+00 DYS	4.8E+02	TC--99	100.
TC-99MD	6.00E+00 HRS	5.4E+03	TC--99	100.
TC--99	[illegible].10E+05 YRS	1.8E-05		
RU-103	[illegible].00E+01 DYS	8.9E-04		
RU-105D	4.43E+00 HRS	1.0E+07	RH-105	100.
RU-106	1.[illegible]0E+00 YRS	6.4E-06		
RH-105	1.50E+00 DYS	1.0E+07		
AG110M	2.60E+02 DYS	4.9E-06		
TE125M	5.80E+01 DYS	4.7E-05		
TE127M+D	1.[illegible]5E+02 DYS	5.3E-06	TE-127	24.
TE-127	9.30E+00 HRS	1.0E+07		
TE129M	3.40E+01 DYS	4.1E-05		

TABLE 129

CASE IV-F -- FILL WANTED DISPOSAL -
FOOD GROWN IN WASTE AFTER 0.5 YEARS DECAY

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129D	1.12E+00 HRS	6.6E+04	I--129	100.
TE131MD	1.20E+00 DYS	7.4E+01	I--131	100.
TE-131D	2.50E+01 MIN	6.0E+03	I--131	100.
TE-132+D	3.25E+00 DYS	1.0E+07	I--132	1.
I--129	1.60E+07 YRS	5.2E-07		
I--130	1.24E+01 HRS	1.0E+07		
I--131	8.05E+00 DYS	1.3E+01		
I--132	2.30E+00 HRS	1.0E+07		
I--133	2.10E+01 HRS	1.0E+07		
I--134	5.20E+01 MIN	1.0E+07		
I--135D	6.70E+00 HRS	8.2E+05	CS-135	100.
CS-134	2.10E+00 YRS	4.9E-05		
CS-135	2.00E+06 YRS	3.1E-04		
CS-136	1.30E+01 DYS	4.0E+00		
CS-137	3.00E+01 YRS	5.7E-05		
CS-138	3.22E+01 MIN	1.0E+07		
BA-140+D	1.28E+01 DYS	4.1E+00	LA-140	55.
BA-141D	1.8[illegible]E+01 MIN	2.0E+02	CE-141	100.
BA-142	1.10E+01 MIN	1.0E+07		
LA-140	1.67E+00 DYS	1.0E+07		
LA-141D	3.90E+00 HRS	1.6E+01	CE-141	100.
LA-142	1.40E+00 HRS	1.0E+07		
CE-141	3.25E+01 DYS	7.3E-02		
CE-143D	1.37E+00 DYS	8.9E+01	PR-143	100.
CE-144	2.85E+02 DYS	3.[illegible]E-04		
PR-143	1.37E+01 DYS	1.0E+01		
PR-144	1.73E+01 MIN	1.0E+07		
ND-147D	1.11E+01 DYS	4.2E-01	PM-147	100.
PM-147	2.60E+00 YRS	5.0E-03		
W--187	2.40E+01 HRS	1.0E+07		
RA-223	1.14E+01 DYS	2.7E+00		
RA-226	1.60E+03 YRS	6.9E-07		
AC-227+D	2.16E+01 YRS	9.8E-06	RA-223	23.
TH-227+D	1.82E+01 DYS	1.2E-02	RA-223	73.
PA-231	3.25E+04 YRS	7.4E-06		
U--235	7.10E+08 YRS	4.9E-05		
NP-239D	2.35E+00 DYS	2.0E+03	PU-239	100.
PU-239	2.44E+04 YRS	5.3E-04		

BASED ON: CONSUMPTION OF FOOD GROWN ON WASTE SITE
A MAXIMUM DOSE COMMITMENT OF 3.00 MREM/YR TO ADULTS
DECAY TIME FROM BURIAL TO INGESTION = 5.0E-01 YEARS
CONSUMPTION OF 150. KG OF FRUITS AND VEGETABLES PER YEAR
CONSUMPTION OF 155. LITERS OF MILK PER YEAR
CONSUMPTION OF 11. KG OF MEAT PER YEAR
CONSUMPTION RATE OF COW = 50. KG/DAY
CONSUMPTION RATE OF CATTLE = 50. KG/DAY
FRACTION OF SOIL WHICH IS WASTE = .20

TABLE 132

CASE IV-F -- FILL WANTED DISPOSAL -
FOOD GROWN IN WASTE AFTER 100 YEARS DECAY

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
H----3	1.23E+01 YRS	2.8E-02		
C---14	5.73E+03 YRS	3.7E-06		
NA--24	1.50E+01 HRS	1.0E+07		
P---32	1.43E+01 DYS	1.0E+07		
CR--51	2.78E+01 DYS	1.0E+07		
MN--54	3.12E+02 DYS	1.0E+07		
MN--56	2.58E+00 HRS	1.0E+07		
FE--55	2.40E+00 YRS	1.0E+07		
FE--59	4.50E+01 DYS	1.0E+07		
CO--58	7.10E+01 DYS	1.0E+07		
CO--60	5.24E+00 YRS	1.3E+02		
NI--59	8.01E+04 YRS	3.9E-04		
NI--63	9.21E+01 YRS	6.3E-05		
NI--65	2.56E+00 HRS	1.0E+07		
CU--64	1.29E+01 HRS	1.0E+07		
ZN--65	2.43E+02 DYS	1.0E+07		
ZN--69	5.50E+01 MIN	1.0E+07		
BR--83	2.40E+00 HRS	1.0E+07		
BR--84	3.20E+01 MIN	1.0E+07		
BR--85	3.00E+00 MIN	1.0E+07		
RB--86	1.87E+01 DYS	1.0E+07		
RB--88	1.80E+01 MIN	1.0E+07		
RB--89D	1.50E+01 MIN	1.0E+07	SR--89	100.
SR--89	5.06E+01 DYS	1.0E+07		
SR--90	2.88E+01 YRS	8.2E-06		
SR--91D	9.70E+00 HRS	1.0E+07	Y---91	100.
SR--92	2.70E+00 HRS	1.0E+07		
Y---90	2.67E+00 DYS	1.0E+07		
Y--91MD	5.00E+01 MIN	1.0E+07	Y---91	100.
Y---91	5.90E+01 DYS	1.0E+07		
Y---92	3.53E+00 HRS	1.0E+07		
Y---93D	1.02E+01 HRS	1.7E+06	NB-93M	99.
ZR--93+D	1.50E+06 YRS	1.3E-03	NB-93M	99.
ZR--95+D	6.50E+01 DYS	1.0E+07	NB--95	99.
ZR--97	1.70E+01 HRS	1.0E+07		
NB-93M	3.70E+00 YRS	1.7E+05		
NB--95	3.50E+01 DYS	1.0E+07		
NB--97	1.20E+00 HRS	1.0E+07		
MO--99D	2.79E+00 DYS	4.8E+02	TC--99	100.
TC-99MD	6.00E+00 HRS	5.4E+03	TC--99	100.
TC--99	2.10E+05 YRS	1.8E-05		
RU-103	4.00E+01 DYS	1.0E+07		
RU-105	4.43E+00 HRS	1.0E+07		
RU-106	1.00E+00 YRS	1.0E+07		
RH-105	1.50E+00 DYS	1.0E+07		
AG110M	2.60E+02 DYS	1.0E+07		
TE125M	5.80E+01 DYS	1.0E+07		
TE127M+D	1.05E+02 DYS	1.0E+07	TE-127	24.
TE-127	9.30E+00 HRS	1.0E+07		
TE129MD	3.40E+01 DYS	9.0E+01	I--129	100.

TABLE 132

CASE IV-F -- FILL WANTED DISPOSAL -
FOOD GROWN IN WASTE AFTER 100 YEARS DECAY

ISOTOPE	HALF-LIFE	LIMITING BURIAL CONCEN. (UCI/GM)	DAUGHTER	PERCENT
TE-129D	1.12E+00 HRS	6.6E+04	I--129	100.
TE131M	1.20E+00 DYS	1.0E+07		
TE-131	2.50E+01 MIN	1.0E+07		
TE-132	3.25E+00 DYS	1.0E+07		
I--129	1.60E+07 YRS	5.2E-07		
I--130	1.24E+01 HRS	1.0E+07		
I--131	8.05E+00 DYS	1.0E+07		
I--132	2.30E+00 HRS	1.0E+07		
I--133	2.10E+01 HRS	1.0E+07		
I--134	5.30E+01 MIN	1.0E+07		
I--135D	6.70E+00 HRS	8.2E+05	CS-135	100.
CS-134	2.10E+00 YRS	1.0E+07		
CS-135	2.00E+06 YRS	3.1E-04		
CS-136	1.30E+01 DYS	1.0E+07		
CS-137	3.00E+01 YRS	5.6E-04		
CS-138	3.22E+01 MIN	1.0E+07		
BA-140	1.28E+01 DYS	1.0E+07		
BA-141	1.80E+01 MIN	1.0E+07		
BA-142	1.10E+01 MIN	1.0E+07		
LA-140	1.67E+00 DYS	1.0E+07		
LA-141	3.90E+00 HRS	1.0E+07		
LA-142	1.40E+00 HRS	1.0E+07		
CE-141	3.25E+01 DYS	1.0E+07		
CE-143	1.37E+00 DYS	1.0E+07		
CE-144	2.85E+02 DYS	1.0E+07		
PR-143	1.37E+01 DYS	1.0E+07		
PR-144	1.73E+01 MIN	1.0E+07		
ND-147D	1.11E+01 DYS	1.0E+07	PM-147	100.
PM-147	2.60E+00 YRS	1.0E+07		
W--187	2.40E+01 HRS	1.0E+07		
RA-223	1.14E+01 DYS	1.0E+07		
RA-226	1.60E+03 YRS	7.2E-07		
AC-227+D	2.16E+01 YRS	2.4E-04	RA-223	23.
TH-227	1.82E+01 DYS	1.0E+07		
PA-231+D	3.25E+04 YRS	4.3E-06	AC-227	24.
U--235	7.10E+08 YRS	4.9E-05		
NP-239D	2.35E+00 DYS	2.0E+03	PU-239	100.
PU-239	2.44E+04 YRS	5.3E-04		

BASED ON: CONSUMPTION OF FOOD GROWN ON WASTE SITE
A MAXIMUM DOSE COMMITMENT OF 3.00 MREM/YR TO ADULTS
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FRACTION OF SOIL WHICH IS WASTE = .20

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