MAINE YANKEE

LTP SECTION 6

COMPLIANCE WITH RADIOLOGICAL DOSE CRITERIA

TABLE OF CONTENTS

Attachments

List of Tables

6.0 COMPLIANCE WITH THE RADIOLOGICAL DOSE CRITERIA

6.1 Introduction

The goal of the MY decommissioning project is to release the site for unrestricted use in compliance with the NRC's annual dose limit of 25 mrem/y plus ALARA and the enhanced State of Maine clean-up criteria of 10 mrem/y or less for all pathways and 4 mrem/y or less for groundwater sources. Both the State and NRC dose limits apply to residual radioactivity that is distinguishable from background. This section provides the methods for calculating the annual dose from residual radioactivity that may remain when the site is released for unrestricted use.

The dose assessment methods are used to determine Derived Concentration Guideline Levels (DCGLs) for nine different potentially contaminated materials. The DCGLs are the levels of residual radioactivity that correspond to the enhanced state clean-up criteria of 10 mrem/y or less for all pathways and 4 mrem/y or less for groundwater sources to the average member of the critical group. The DCGLs developed to demonstrate compliance with the enhanced State criteria are intended to also serve to demonstrate compliance with the NRC's 25 mrem/y plus ALARA regulation.

Maine Yankee intends to dismantle equipment and systems and remediate structures and land areas (per LTP Sections 3 and 4) to ensure that residual radioactivity levels are at, or below, the DCGLs. After remediation is completed, a final site survey will be performed (per LTP Section 5) to verify compliance with the DCGLs. The final survey report will document that the DCGLs have been met and serve to demonstrate that the Radiological Criteria for License Termination, as codified in 10 CFR 20 Subpart E and Maine State Law LD 2688-SP 1084 have been fully satisfied.

A dose assessment will be performed for each of the following materials: 1) contaminated building basement surfaces; 2) embedded pipe; 3) activated concrete/rebar; 4) groundwater; 5) surface water; 6) surface soils; 7) buried piping/conduit; 8) deep soils; and 9) Forebay sediment. Appropriate dose models and model input parameters were developed and justified for each material. The dose from each material was evaluated and summed with that from other materials as necessary to determine the total dose to the average member of the critical group.

6.2 Site Condition After Decommissioning

This section provides a brief overview of the planned site condition after decommissioning as well as a summary of site geology and hydrology. Detailed information on the planned final site condition is provided in Section 3.2.4. LTP Section 8.4 provides a more detailed overview of the geological and hydrological characteristics of the site.

In general, when decommissioning is complete the site will be predominantly a backfilled and graded land area restored with indigenous vegetative cover. The only above grade structures remaining per the current plans include the 345 KV switchyard. The former Low-Level Waste Storage Building (now the ISFSI Security Operations Building) will remain in place until the fuel is removed from the ISFSI. Building basements and foundations greater than three feet below grade will be backfilled and left in place. Buried piping that is at least three feet below grade will be remediated as necessary, surveyed, and abandoned in place.

6.2.1 Site Geology and Hydrology

The site geology consists of a series of ridges and valleys striking north-south that reflect the competency and structural nature of the underlying bedrock. Deep valleys are filled with glaciomarine clay-silt soil and ridges are characterized by exposed bedrock or thin soil cover over rock. Surface drainage moves both to the north and south along the axes of the topographic valleys and also runs east and west down the flanks of the ridges. In the plant area, where the ground surface is relatively flat, manmade underground storm drains and catch basins control the surface runoff. In the area south of Old Ferry Road, drainage from a large area north of Old Ferry Road and the northern half of Bailey Point discharges in underground manmade piping to Bailey Cove.

The groundwater regime at the Maine Yankee facility is comprised of two aquifers: (1) a discontinuous surficial aquifer in the unconsolidated glaciomarine soils and fill material; and (2) a bedrock aquifer. The surficial aquifer is not present continuously across the site, as the overburden soils are thin to non-existent in some portions of the site. This is especially true in the southern portion of Bailey Point. The bedrock aquifer is present below the entire site and vicinity.

Groundwater originating near the surface in the northern portion of the site generally moves vertically into the soil except in the wetland areas where groundwater discharge locally occurs. After slow movement through the soil, the groundwater moves into the deeper bedrock and travels toward the bay, discharging upward in the near-shore area. In the southern portion of the site, groundwater originating near ground surface generally stays near the surface, rather than penetrating deep into the bedrock.

During plant operation, impacts to the groundwater flow regime were limited to draw-down of the groundwater surface caused by foundation drains around the containment structure and, to a lesser extent, draw-down caused by active water supply wells. Following decommissioning of the containment structure, groundwater levels will recover to approximate pre-construction levels.

6.3 Critical Group

The regulations in 10 CFR 20 Subpart E require the dose to be calculated for the average member of the critical group. The critical group is defined in 10CFR20.1003 as “the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances.” The average member of the critical group is a conservative approach and is also used for demonstrating compliance with the dose criteria in Maine State Law LD 2688-SP 1084. The critical group selected for the MY site dose assessment is the resident farmer.

The resident farmer is a person who lives on the site after the site is released for unrestricted use and derives all drinking and irrigation water from an onsite well. In addition, a significant portion of the resident’s diet is assumed to be derived from food grown onsite. NRC guidance in NUREG-1727, Regulatory Guide DG-4006, NUREG-1549, and NUREG-5512 identify the resident farmer as a conservative onsite critical group. The resident farmer critical group applies to existing open land areas and all site areas where standing buildings have been removed to three feet below grade.

It is unlikely that other future site uses would result in a dose exceeding that calculated for the hypothetical resident farmer. It is more probable that actual future occupants of the site would engage in behaviors that would result in lower doses. For example, it is more likely that a hypothetical future resident would use the municipal water supply, as opposed to well water, since this is the common practice in the vicinity of the site and the yield from onsite test wells has been determined to be low and not suitable for consumption. Further, it is most likely that the site will be limited to industrial use. In this case the future site occupant would be a worker as opposed to the resident farmer. A third example would be an onsite resident who does not derive a significant fraction of dietary needs from an onsite farm. The important conclusion from these examples is that the dose calculated for the hypothetical resident farmer will likely be a conservative estimate of the dose that an actual site occupant or site visitor would receive.

Maine Yankee has assessed the potential for the filled basements to be excavated and occupied at some time in the future and does not believe that this scenario meets the "reasonable expectation" threshold required by the definition of a critical group in 10 CFR 20.1003. As stated in NUREG-1727, page C26, compliance with the dose limit does not require an investigation of all possible scenarios and the use of the average member of the critical group is intended to emphasize the uncertainty and assumptions needed in calculating potential future dose, while limiting "boundless speculation" on possible future exposure scenarios. As discussed above, selecting the resident farmer critical group is a sufficiently conservative projection of future land use. Further assuming that an individual excavates filled basements and attempts to renovate and occupy the basements is not considered plausible and results in excessive conservatism.

Notwithstanding the very low probability of excavation occurring, Maine Yankee will limit the potential activity on basement fill to concentrations below the surface soil DCGL level corresponding to 10 mrem/y. In addition, cost studies conducted to date indicate that it is more expensive to remediate soil than basement surface contamination. As discussed in Section 6.9, the selected Basement Contamination DCGLs are limited in order to maximize soil DCGL levels. The cost optimization process supported selecting Basement Contamination DCGLs that are below the NRC screening values for standing building surfaces. At these levels, the resident farmer dose was calculated to be 0.59 mrem/y from contamination on basement surfaces and ensures very low dose for any future land use.

6.4 Conceptual Model

The Conceptual Model for dose to the resident farmer critical group is different to some extent for each contaminated material due to the different physical characteristics of the materials and different source term radionuclides. The Conceptual Model for each material is described in detail in Section 6.6.

In general, the overall site Conceptual Model includes a resident farmer who lives on the site after release for unrestricted use, draws drinking water and irrigation water from the worst-case onsite well location, and derives a substantial percentage of annual food requirements from the onsite resident farm.

The hypothetical dose from each potentially contaminated material is evaluated independently. However, the total resident farmer dose results from the summation of the contributions from all materials and all pathways. The method for summing the doses and selecting DCGLs for all contaminated materials is provided in Section 6.7.

6.5 Environmental Media and Dose Pathways

6.5.1 Contaminated Materials

There are nine contaminated materials that could contribute to dose:

a. Embedded pipe
b. Buried pipe/conduit
c. Activated concrete/rebar
d. Groundwater
e. Surface Water
f. Basement surfaces
g. Surface soil
h. Deep soil
i. Forebay Sediment

6.5.2 Environmental Media

After considering radionuclide transfer from the nine contaminated materials, there are five environmental media that could deliver dose to the resident farmer. These are groundwater, surface soil, deep soil, surface water, and basement fill. Groundwater concentration may increase through the transfer of radionuclides from contaminated basement surfaces, activated concrete/rebar, deep soil, and embedded pipe. Note that the "groundwater" environmental medium includes contributions from water contained in building basements as well as other sources. Basement fill may also become slightly contaminated through the transfer of contamination from basement surfaces, embedded piping, and activated concrete/rebar. Table 6-1 indicates which environmental media are affected by the transfer of radionuclides from contaminated materials.

The residual contamination in the Forebay sediment is not transferred to any of the five environmental media and is evaluated independently. Therefore, Forebay sediment is not included in Table 6-1.

6.5.3 Dose Pathways

The five environmental media listed in Table 6-1 deliver dose to the resident farmer through one or more of the following dose pathways: 1) drinking water; 2) direct exposure; 3) ingesting soil, plants, animals, or fish; and 4) inhaling resuspended soil. These pathways are consistent with those listed in NUREG-1549 for the resident farmer. A given environmental medium will not contribute dose through all pathways.

Table 6-2 lists the dose pathways applicable to each environmental medium. Note that groundwater contributes to the plant and animal pathways through irrigation.

6.5.4 Radionuclide Concentrations in Environmental Media

To calculate the dose from each pathway the radionuclide concentrations in each environmental medium must be calculated. The concentrations in the surface soil, deep soil, and surface water can be used directly in the dose assessment since there is no contribution from other contaminated materials. However, the final concentrations in groundwater and basement fill, and the resulting dose, will depend on the transfer of contamination from other materials. Final concentrations in the five environmental media are calculated by summing contributions from various materials as listed below.

The contaminated materials that contribute to each of the environmental media are summarized below. The materials in brackets are those requiring transfer evaluations.

- Groundwater Concentration = [basement surface contamination] + [embedded pipe] + [activated concrete/rebar] + [deep soil] + [buried pipe/conduit] + existing groundwater concentration

- Basement Fill Concentration = [basement surface contamination] + [embedded pipe] + [activated concrete/rebar]
- Surface Soil Concentration = surface soil concentration

- Deep Soil Concentration = [buried pipe/conduit] + deep soil concentration
- Surface Water Concentration = surface water concentration

Table 6-1
Environmental Media Affected by Transfer from Contaminated Materials

	Ground Water	Surface Soil	Deep Soil	Surface Water	Basement Fill
Basement Contamination	X				X
Surface Soil		X			
Deep Soil	X		X		
Groundwater	X				
Embedded pipe	X				X
Surface Water				X	
Activated concrete/rebar	X				X
Buried Pipe/Conduit	X		X		

Table 6-2
Environmental Media and Dose Pathways for the Resident Farmer Scenario

	Direct Radiation	Drinking Water	Plant, Animal, Soil Ingestion	Inhalation	Fish Ingestion
Surface Soil	X		X	X	
Deep Soil	X				
Basement Fill	X				
Groundwater		X	X*	X*	
Surface Water		X			X

* These pathways result through irrigation

6.6 Material Specific Dose Assessment Methods and Unitized Dose Factors

Each material has unique characteristics that must be considered when developing the conceptual and mathematical model for dose assessment. This section provides the dose assessment methods and results for each material in a unitized format by expressing the dose as a function of unit concentrations such as 1 dpm/100 cm^2 or 1 pCi/g. The unitized format facilitates the summation of doses from all materials and the selection of material specific DCGLs (see Section 6.7).

6.6.1 Contaminated Basement Surfaces

a. Conceptual Model

The Dose Model for contaminated basement surfaces assumes that the buildings are demolished to three feet below grade. The remaining basements are then decontaminated as necessary, filled with a suitable material (current plans call for fill with Bank Run Sand) and the area restored to grade, which results in a three-foot cover over the top of the filled basements. After the site is restored, rainwater and groundwater infiltrate into the basements and occupy the void space in the fill material. The available void space volume is a function of the fill material porosity.

The entire inventory of contamination on the basement surfaces, including the concrete and steel liner, is assumed to be instantaneously released and mixed with the water that has infiltrated into the basements. In this context, "surface" is intended to include all radioactivity, at all depths (this does not include activated concrete, which is treated as a separate material). Analyses of Maine Yankee concrete have indicated that, on average, the contamination is about 1 mm deep in the concrete. The liner contamination should be true surface contamination, i.e., not at any significant depth.

Using a mass balance approach, the radionuclides that are released from the surfaces are assumed to instantaneously reach equilibrium between the water, fill, and concrete. The relative equilibrium concentrations in the water, fill, and concrete are a function of the material Kd, mass, and porosity.

The critical group is the resident farmer who is assumed to drill a domestic water well into the worst case basement, i.e., that with the highest basement surface area to volume ratio. The amount of activity available for release is assumed to be directly proportional to the surface area of contaminated material. Therefore, the highest surface area/volume ratio results in the maximum radionuclide inventory and maximum concentrations in the water, fill, and concrete. The resident farmer is also assumed to occupy the land immediately above the basement, which maximizes direct exposure through the 3-foot cover. (Since the resident farmer is assumed to receive dose from exposure to surface soil based on 100% stay-time, the additional direct dose from basement fill is a conservative addition to dose. Thus, no credit is taken overall for the absence or presence of the 3 foot cover.)

The conceptual model results in three dose pathways to the resident farmer: 1) drinking water from the well; 2) irrigating with water from the well; and 3) direct radiation from radionuclides in the fill.

b. Mathematical Model

A mathematical model was developed to calculate the equilibrium radionuclide concentrations in the basement water, fill, and concrete after the infiltration of rainwater and groundwater. Contamination is assumed to diffuse into and re-adsorb on concrete surfaces since concrete is a porous media. The re-adsorption on the steel liner is expected to be less than the concrete and is considered to be bounded by the concrete analysis. The mathematical model includes calculations to determine the resident farmer dose from drinking water derived from a well drilled directly into the basement fill, irrigating with the water, and being directly exposed to the covered fill. The model is intended to be a simple, conservative, screening approach.

The radionuclide inventory, water volume, fill volume, and concrete volume subject to re-adsorption are the quantities required to determine the equilibrium radionuclide concentrations in the three materials. The initial condition of the model is that a volume of water has infiltrated into the basement that is equal to the annual volume required for drinking, domestic use, and irrigation by the resident farmer. As stated above, the well is placed directly into the basement fill containing the water. From this initial condition the volumes and masses of the three materials, and the maximum radionuclide inventory released to the water, can be calculated.

The annual resident farmer well-water usage is assumed to be 738 m^3 (justification provided below). This implies that the fill volume is 738 m^3 divided by the porosity of the soil, which is assumed to be 0.3 (justification provided below). Therefore, the model fill volume is

2460 m^3. This is the minimum fill volume required to contain the annual resident farmer water volume. Depending on the infiltration rate, smaller fill volumes could supply the required 738 m^3/y water volume, but this would result in slightly lower average annual concentrations. Assuming a model volume of 2460 m^3, and no dilution through infiltration recharge, is the most conservative approach.

The actual basement open volumes of the PAB, Spray, and Fuel buildings are less than 2460 m^3, but the containment basement volume is greater, i.e., 8217 m^3. The larger containment volume has no effect on the result since the additional hypothetical water volume does not affect the radionuclide concentrations in the water, or the assumed annual water use. In fact, as explained below, using actual containment basement dimensions, including volume and surface area, would reduce water concentrations by a factor of 3.7 since the surface area to volume ratio for the containment basement is lower than that used in the model. The effect of surface area to volume ratio and the rationale for selecting the value used in the model are described below.

The basement surface area to open volume ratios have a direct effect on the results and are necessary for determining two parameters. The most important affected parameter is the maximum radionuclide inventory. Less important, but also related, is the volume of concrete available for re-adsorption of radionuclides. Using the maximum surface area/volume ratio from the four basements maximizes the radionuclide inventory and the resulting water, fill, and concrete concentrations.

The maximum ratio of concrete surface area/basement open volume of 1.7 m^2/m^3 is found in the Spray building basement. The surface area/volume ratios for the Containment, PAB, and Fuel buildings are 0.46 m^2/m^3, 1.03 m^2/m^3, and 0.49 m^2/m^3, respectively. Using the maximum ratio of 1.7 m^2/m^3 results in conservative dose calculations for the Containment, PAB, and Fuel buildings by factors of 3.7, 1.65, and 3.5 respectively. If necessary, as the project proceeds, Maine Yankee may use building-specific surface area/volume ratios based on the data presented in Section 6.6.1(d)(2) to calculate building-specific DCGLs.

Multiplying the 1.7 m^2/m^3 ratio by the fill volume (2460 m^3) results in the maximum contaminated surface area that could contribute to the source term for a given 738 m^3 of water. Accordingly, the maximum surface area in the model would be 4182 m^2, which exceeds the actual surface area of any of the building basements. This occurs because the 1.7 m^2/m^3 ratio is from the Spray building and the maximum surface area of 3775 m^2 is in the Containment building. However, consistent with a conservative screening approach, and to maintain the correct mathematical relationships between porosity, annual water volume, and surface area, the 4182 m^2 surface area will be used in the model. Note that using 3775 m^2 would reduce the available source term and thereby reduce water concentrations.

Assuming that the water penetrates to a depth of 1 mm in the concrete, the concrete volume available to re-adsorb radionuclides from contaminated water is 4.2 m^3. The 1 mm depth is based on analyses of contaminated Maine Yankee concrete. Although the conditions are different, i.e., water saturation after decommissioning versus periodic wet contamination events during operation, the penetration of water into the concrete after the basements are filled with water is also assumed to be 1 mm. This is considered a conservative assumption since increasing the concrete penetration depth will decrease the concentrations in the fill and in the water.

The model uses two approximations related to re-adsorption onto concrete that have a very small effect on the final results. First, the fill volume is calculated assuming all of the 738 m^3 water volume is contained in the fill, not mixed between the fill and concrete. An exact solution would require consideration of both the fill and concrete volumes simultaneously. However, the affected concrete volume is very low and the corresponding water volume in the concrete is about 1 m^3. This is less than 1% of the 738 m^3 total and is insignificant. Second, the porosity of 0.3 is assumed to apply to both fill and concrete. The same porosities are used in the model in order to produce the simplified solution provided in Equation 7. However, site-specific measurements indicate that the actual concrete porosity is 0.15. Using a porosity of 0.15 would decrease the volume of water in the concrete to about 0.5 m^3. An exact solution to these two approximations would have a very small effect on the results and is an unnecessary level of detail considering the conservative screening approach used in the model.

The approach assumes uniform mixing among the soil, water, and concrete. Uniform mixing within the fill is not unreasonable considering the surface area to volume ratio of 1.7 m^2/m^3. Assuming a planar geometry, this means that the water is required to mix over a distance of 0.6 m in the backfill. Although assuming planar geometry is a simplification, it demonstrates that water mixing over long distances in the fill is not intrinsic to the validity of the screening model.

The calculations for determining the equilibrium concentrations in the basement water, fill, and concrete are based on a mass balance approach. The total mass in the system, M_t, is the sum of the mass in the water (M_w), the mass sorbed to the fill (M_b), and the mass sorbed to the concrete (M_c). For these calculations, mass is expressed as activity, A. The total activity, A_t, is the total radionuclide inventory in the 4182 m^2 basement concrete surface under consideration. Equations (1) through (7) described below are solved for each radionuclide in the Maine Yankee Radionuclide Mixture.

$$A_t = A_w + A_f + A_c \tag{1}$$

Where: A_t is total activity (pCi)
A_w is the total activity in water (pCi)
A_f is the total activity in the fill (pCi)
A_c is the total activity in the concrete (pCi)

The activity in the water is defined as:

$$A_w = çC\ V_t \tag{2}$$

Where: ç is the porosity of the fill and concrete
C is the concentration in solution (pCi/l) and,
V_t is the total system volume (sum of the volume of fill and concrete, m^3).

At equilibrium the activity adsorbed to the fill and concrete is directly proportional to the concentration in the water. The proportionality constant used in these calculations is the distribution coefficient, Kd, and has units of cm^3/g. Distribution coefficients are widely accepted measures of sorption onto the solid phase, and the solid/liquid phase ratio, and are accepted for use in risk assessments by national and international regulatory agencies and scientific organizations including the U.S. Nuclear Regulatory Commission and the U.S. Environmental Protection Agency.

The activity adsorbed on the fill and the concrete can be represented as:

$$A_f = ñ_f Kd_f C\ V_f \qquad (3)$$

Where:
- $ñ_f$ is fill bulk density (g/cm^3)
- Kd_f is fill distribution coefficient
- C is water concentration(pCi/l)
- V_f is fill volume (m^3)

and

$$A_c = ñ_c\ Kd_c\ C\ \ V_c \qquad (4)$$

Where:
- $ñ_c$ is concrete bulk density (g/cm^3)
- Kd_c is concrete distribution coefficient
- C is water concentration (pCi/l)
- V_c is concrete volume (m^3)

The bulk density of the fill is assumed to be 1.5 g/cm^3 based on analyses of potential fill (reference provided below). For the concrete, a site-specific value of 2.2 g/cm^3 was used (reference provided below). V is the volume of the solid phase; V_f is 2460 m^3 and V_c is 4.2 m^3.

Combining the terms from Equations (2), (3), and (4) gives:

$$A_t = çC\ V_t + ñ_f Kd_f C\ V_f + \ ñ_c\ Kd_c\ C\ \ V_c \qquad (5)$$

Multiplying the second and third terms by $(çV_t)/(çV_t)$, i.e., 1, and rearranging gives:

$$A_t = çC\ V_t + (çV_t\ C)(\ ñ_f Kd_f V_f)\ /(çV_t\ ) + (ç\ V_t\ C)(ñ_c\ Kd_c V_c)/(ç\ V_t) \qquad (6)$$

Recognizing from Equation (1) that the term, $çC\ V_t$ is the activity in the water phase, A_w, allows Equation 6 to be rewritten as:

$$A_t = A_w(1 + ñ_f (Kd_f/ç)(V_f/V_t) + \ ñ_c\ (Kd_c/ç)(V_c/V_t)) \qquad (7)$$

To calculate the water concentration, drinking water dose, concentration in the fill, and concentration on the concrete surfaces, Equation (7) is first solved for A_w. All of the terms in Equation (7) are known except A_w. The water concentration, C, is then calculated using Equation (2). After solving for C, the backfill and concrete concentrations are calculated using Equations (3) and (4).

c. Dose Calculations

The concentrations in the basement water and fill are used to calculate dose. There are three dose pathways to the resident farmer after the fill is placed in the basements, the three-foot cover is completed, and water infiltrates the basements. These are drinking water dose, irrigation dose, and direct dose. The dose calculations are described in Equations (8) through (10). The equations are used to calculate dose for each radionuclide in the Maine Yankee mixture.

There will be no ingestion or inhalation associated with the fill because of the presence of the cover. Ingestion or inhalation could occur if the fill were excavated at some time in the future. To account for this possibility, the projected basement fill concentration is limited to ensure that the concentration will not exceed the surface soil DCGL and that the dose will not increase over that calculated with the earthen cover in place. In fact, the hypothetical dose would decrease if the fill were excavated at some time in the future.

1. Drinking Water Dose

Drinking water dose is calculated from the radionuclide concentrations in the basement water. As shown in Table 6-1, the basement water is one of several contributors to drinking water dose. The annual water intake is assumed to be 478 L/y consistent with the default values in the NRC screening code, DandD, Version 1. Dose conversion factors are taken from Federal Guidance Report No. 11.

$$Dose_{dw} = (\ C\ pCi/l)(478\ L/y)(DCF\ mrem\text{-}y/pCi) \qquad (8)$$

Where: C is water concentration in pCi/L
DCF is FGR 11 dose conversion factor

2. Irrigation Dose

Including irrigation dose is conservative because irrigation in Maine is uncommon due to relatively high annual precipitation. However, consistent with a screening approach it is included. The irrigation rate is assumed to be 0.274 L/m^2/d (justification provided below). The source of the water is the resident farmer well placed in the building basement. The annual irrigation volume is mixed in a 15 cm depth of soil, which is consistent with the NRC DandD model as described in NUREG-5512, Volume 1. The dose from the resulting soil concentrations were calculated using the NRC screening values in NUREG-1727, Table C2.2 , converted to mrem/y per pCi/g.

$$Dose_{irrigation} = (C_{soil}\ pCi/g)(NUREG\text{-}1727\ mrem/y\ per\ pCi/g) \quad (9)$$

Where: $Dose_{irrigation}$ is the annual dose from irrigation (mrem/y)
C_{soil} is soil concentration in pCi/g
(NUREG-1727) is the soil screening value from NUREG-1727, Table C2.3 converted to mrem/y per pCi/g

$$C_{soil} = \frac{(pCi/L\ in\ water)(0.274\ L/m^2/d)(365\ d)(1\ m^2)}{(1m^2)(0.15\ m)(1E+06\ cm^3/m^3)(1.6\ g/cm^3)} \quad (10)$$

3. Direct Dose

The direct dose was calculated using the Microshield code assuming a three-foot soil cover, 10,000 m^2 area, and 5.8 m depth. The 5.8 m depth represents the deepest basement, i.e., containment. The Microshield result for “Deep Dose Equivalent, Rotational Geometry,” was used and is generally referred to as “exposure.” The resulting exposure rate was multiplied by the annual outdoor occupancy time of 964 hours (0.1101 x 365 days x 24 hr/day) from the NRC DandD, Version 1, screening code to calculate the annual direct exposure dose. The Microshield output reports are provided in Attachment 6-1.

d. Model Input Parameters

The following section describes and justifies the parameters used in the concentration and dose calculations.

1. Distribution Coefficients, Kd

Fill Kd values were either derived from literature (mean values) or from the results of analyses of site-specific fill materials. The site-specific Kd analyses were performed by Brookhaven National Laboratory (BNL) (results provided in Attachment 6-2). At this time, the most likely fill material is Bank Run Sand. Therefore, the average Kd's for Bank Run Sand from Attachment 6-2 were used in the model. Table 6-3 lists the fill Kd's, and the reference, for each radionuclide.

Concrete Kd values were either derived from literature or from the results of site-specific Kd analyses. The site-specific Kd analyses were performed by BNL (results provided in Attachment 6-3). Table 6-3 lists the concrete Kd's, and the reference, for each radionuclide. It is seen that for cement, a few Kd's were left blank. This indicates data were not available and a value of 0 was used in the calculations. A Kd of 0 maximizes the concentration in water. In addition, the Krupka reference did not contain Kd information for cobalt or iron. It was assumed that the Kd's for these two metals were the same as nickel. However, the overall effect of the concrete is small, regardless of Kd.

2. Maximum Surface Area to Volume Ratio

The building basements that will remain following demolition of site structures include the Containment, PAB, Spray and Fuel Building basements. The open-air volumes of the basements are 8217 m^3, 1584 m^3, 1136 m^3, and 837 m^3 respectively. This represents the volume of fill required in each basement. The wall and floor surface areas are 3775 m^2, 1637 m^2, 1883 m^2, and 409 m^2 respectively. The basement volumes and surface areas were determined in Maine Yankee calculation EC 01-00(MY). The maximum surface area to volume ratio of 1.7 m^2/m^3 is found in the Spray building basement.

Table 6-3
Selected Kd Values (g/cm^3) for Basement Fill Model

Radionuclide	Mean Fill Kd	Reference for Mean Kd	Concrete Kd	Reference for Kd in cement
H-3	0		0	
Fe-55	25	Baes, Table 2.13	100	Krupka Table 5.1
Ni-63	12	Attachment 6-2	100	Krupka Table 5.1
Mn-54	50	Sheppard, Table A-1		
Co-57	13	Attachment 6- 2	100	Krupka Table 5.1
Co-60	13	Attachment 6-2	100	Krupka Table 5.1
Cs-134	56	Attachment 6-2	3	Attachment 6-3
Cs-137	56	Attachment 6-2	3	Attachment 6-3
Sr-90	6	Attachment 6-2	1.0	Attachment 6-3
Sb-125	45	Sheppard, Table A-1		
Pu-238	550	Sheppard, Table A-1	5000	Krupka Table 5.1
Pu-239/240	550	Sheppard, Table A-1	5000	Krupka Table 5.1
Pu-241	550	Sheppard, Table A-1	5000	Krupka Table 5.1
Am-241	1900	Sheppard, Table A-1	5000	Krupka Table 5.1
Cm243/244	4000	Sheppard, Table A-1	5000	Krupka Table 5.1
C-14	5	Sheppard, Table A-1		
Eu-152	400	Onishi, Table 8.35		
Eu-154	400	Onishi, Table 8.35		

3. Porosity

The porosity of the fill material is assumed to be 0.3. The range of mean porosities for a wide variety of soil types are listed in NUREG-5512, Volume 3, "Residual Radioactive Contamination From Decommissioning. Parameter Analysis," Page 6-64,

Table 6.41. The porosities listed in NUREG-5512 ranged from 0.36 to 0.49.

The projected dose from contaminated concrete in the basement fill model decreases with increasing porosity. However, the projected doses from the embedded pipe and activated concrete increase with increasing porosity. This is because the source term for embedded and buried piping is constant and the source term for contaminated concrete is a function of surface area. All three dose assessment models are conservative. However, the activated concrete and embedded piping source term assumptions are much more conservative than those used for the basement concrete and the resulting dose is a small fraction of that from contaminated concrete. Therefore, the porosity effect on the contaminated concrete dose is used to select a porosity at the lower end of the range, e.g., 0.3.

4. Annual Drinking Water Volume

The annual drinking water volume was assumed to be 478 l/y. This is the default volume from NRC DandD, Version 1 screening code.

5. Irrigation Rate and Annual Irrigation Volume

Annual irrigation volume was based on interviews with representatives of the Maine USDA-NRCS. The individuals contacted are documented in a memorandum provided in Attachment 6-4. The USDA representatives indicated that irrigation in Maine is uncommon, but that in drought years irrigation may occur. The Maine USDA representatives indicated that the drought irrigation rate for a family garden would not be expected to exceed 4-5 in/y (10 to 12 cm/y). The 10 cm/y rate was used in the model, which can be converted to 0.274 $l/m^2/d$. To calculate total annual volume, the 10 cm/y rate was multiplied by the default cultivated area of 2400 m^2 from the DandD screening model (NUREG-1727, Appendix C, Section 2.3.2). This results in the annual irrigation volume of 240,000 l/y.

6. Annual Domestic Water Use

Annual domestic water volume is derived from NUREG-5512, Volume 3, Page 6-37, Table 6-19. The per capita consumption rate for the State of Maine is listed as 124,422 l/y. Assuming a family of four, this corresponds to a total domestic water volume of 497,688 l/y. The assumption of four occupants is based on the land occupancy rate from NUREG-1727, Table D2, of 0.0004 persons/m^2 and an assumption that the resident farm size is 10,000 m^2.

7. Total Resident Farmer Annual Well Water Volume

The total annual volume of water from the resident farmer well is the sum of the domestic use plus irrigation use. Domestic use is 497,688 l/y and irrigation use is 240,000 l/y for a total of 737,688 l/y. A rounded value of 738 m^3/y was used in the model.

8. Concrete Density

Concrete density was determined by site-specific analysis to be 2.2 g/cm3 (Attachment 6-5).

9. Fill Material Density

Density of the possible fill material is 1.5 g/cm^3 (Attachment 6-2). This corresponds to Bank Run Sand.

10. Soil Density

Density of soil is 1.6 g/cm^3 based on an average of the densities of Bank Run Sand and Bank Run Gravel from Attachment 6-2. This average is assumed to be representative of the site soil, which is comprised primarily of backfill.

11. Dose Conversion Factors (DCFs)

The DCFs are in units of Committed Effective Dose Equivalent (CEDE) and are taken from Federal Guidance Report No. 11, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion," Table 2.2, EPA-520/1-88-020.

12. Outdoor Occupancy Time

The DandD, Version 1, default value of 0.1101 y or 965 hr/y is used.

e. Unitized Dose Factors for Contaminated Basement Surfaces

Using Equations 1-10 above, the radionuclide concentrations in basement water, fill, and concrete, and the dose to the resident farmer were calculated using a simple spreadsheet application. The activity of each radionuclide in the Maine Yankee mixture for contaminated surfaces was set to1 dpm/100 cm^2 of surface area. The surface was assumed to be concrete for the purpose of the calculation to evaluate the potential effect of re-adsorption on concrete. The spreadsheet output and the resulting unitized dose factors are provided in Table 6-4 (see next page).

6.6.2 Activated Basement Concrete/Rebar

a. Conceptual Model

Activated concrete and rebar is present in the ICI sump area in the containment building. The current plan is to remediate activated concrete exceeding 1 pCi/g total activity (sum of all radionuclides) and any rebar associated with this concrete. The walls and floors consist primarily of concrete with rebar being a small percentage. Characterization results indicate that the total activity concentration in rebar is about 1.9 times higher than the concrete surrounding the rebar. In addition, the radionuclide mixtures for concrete and rebar differ as indicated in Table 2-9. However, as shown in Attachment 6-17, the calculated dose from the rebar is less than the dose from the surrounding concrete (see Table 6-11 for activated concrete dose), accounting for both the higher relative concentration and the rebar radionuclide mixture. The concrete dose was 4.63 E-2 mrem/y and the rebar dose was 1.93 E-2 mrem/y. Therefore, the walls and floors are conservatively assumed to be comprised entirely of activated concrete in the dose calculation.

Table 6-4
Contaminated Basement Surfaces Unitized Dose Factors

Key Parameters

Porosity	0.30		Bulk Density	1.50	g/cm^3	Yearly Drinking Water	478.00	L/yr
Wall Surface Area	4182.0	m^2	Fill Volume	2460.00	m^3	Surface Area/Open Volume	1.70	m^2/m^3
Concrete Volume	4.18	m^3	Concrete Density	2.20	g/cm^3	Annual Total Well Water Vol	738.00	m^3
Irrigation Rate	0.274	L/m^2-d	Surface Soil Depth	0.15	m			

DOSE CALCULATION FACTORS				SOURCE TERM		Kd		WATER, FILL, CONCRETE CONCENTRATION				CONTAMINATED CONCRETE ANNUAL DOSE				
Nuclide	NUREG-1727 mrem/y per pCi/g	FGR 11 mrem/ pCi	Mcroshield mrem/y per pCi/g	Inventory dpm/100 cm^2	Inventory pCi	Kd Fill cm^3/gm	Kd Concrete cm^3/gm	Adsorption Factor	Water pCi/L	Fill pCi/g	Concrete pCi/g	Nuclide	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Sr-90	1.47E+01	1.42E-04	0.00E+00	1.00E+00	1.88E+05	6.00E+00	1.00E+00	3.10E+01	8.23E-03	4.94E-05	8.23E-06	Sr-90	5.59E-04	5.38E-05	0.00E+00	6.12E-04
Cs-134	4.39E+00	7.33E-05	6.09E-05	1.00E+00	1.88E+05	5.60E+01	3.00E+00	2.81E+02	9.08E-04	5.09E-05	2.72E-06	Cs-134	3.18E-05	1.77E-06	3.10E-09	3.36E-05
Cs-137	2.27E+00	5.00E-05	1.20E-05	1.00E+00	1.88E+05	5.60E+01	3.00E+00	2.81E+02	9.08E-04	5.09E-05	2.72E-06	Cs-137	2.17E-05	9.16E-07	6.10E-10	2.26E-05
Co-60	6.58E+00	2.69E-05	6.30E-04	1.00E+00	1.88E+05	1.30E+01	1.00E+02	6.71E+01	3.80E-03	4.93E-05	3.80E-04	Co-60	4.88E-05	1.11E-05	3.11E-08	5.99E-05
Co-57	1.67E-01	1.18E-06	2.80E-08	1.00E+00	1.88E+05	1.30E+01	1.00E+02	6.71E+01	3.80E-03	4.93E-05	3.80E-04	Co-57	2.14E-06	2.82E-07	1.38E-12	2.42E-06
Fe-55	2.50E-03	6.07E-07	0.00E+00	1.00E+00	1.88E+05	2.50E+01	1.00E+02	1.27E+02	2.01E-03	5.01E-05	2.01E-04	Fe-55	5.82E-07	2.23E-09	0.00E+00	5.84E-07
H-3	2.27E-01	6.40E-08	0.00E+00	1.00E+00	1.88E+05	0.00E+00	0.00E+00	1.00E+00	2.55E-01	0.00E+00	0.00E+00	H-3	7.80E-06	2.57E-05	0.00E+00	3.35E-05
Ni-63	1.19E-02	5.77E-07	0.00E+00	1.00E+00	1.88E+05	1.20E+01	1.00E+02	6.21E+01	4.10E-03	4.92E-05	4.10E-04	Ni-63	1.13E-06	2.17E-08	0.00E+00	1.15E-06

With the exception of the source term calculation, the conceptual model for activated concrete is identical to the conceptual model for contaminated basement surfaces described above. A conservative screening approach was used to account for the activated concrete source term by assuming that the entire inventory of the residual activity in the activated concrete, at all depths, is immediately released into the 738 m^3 of water in the basement fill. A more realistic model would account for the fact that the activated inventory would be released very slowly over time and that the concentration would decrease with depth. Concentration decreases with depth since the most highly activated concrete will have been removed during remediation. In addition, the concrete concentration at all depths is assumed to be equal to the surface concentration of 1 pCi/g. This is conservative since the concentration will actually decrease with depth. However, since the dose using the screening approach was very low, the detailed analyses required to justify release rates and actual concentrations with depth were not necessary.

b. Unitized Dose Factors for Activated Concrete

Although activated concrete is present at depth beneath the surface, the unit dose calculation for activated concrete is based on a concentration of 1 pCi/g total activity (sum of all radionuclides) at the surface of the floors and walls of the ICI sump. The surface activity (measured volumetrically) is the measurable quantity that will be used to demonstrate compliance during the final status survey. However, the total inventory, i.e., source term, includes the radionuclides in the entire volume of activated concrete, including surface and subsurface. The total inventory was determined to be 3.43E+08 pCi as described in Attachment 6-6. This inventory may change if the remediation level (i.e., DCGL) for activated concrete is changed. The final dose assessment will be based on the actual remediation level selected.

To determine the inventory of each radionuclide, the total 3.43E+08 pCi inventory must be multiplied by the radionuclide fraction in the activated concrete mixture. The resulting radionuclide specific inventories are input to the “inventory” column in the spreadsheet developed for the contaminated basement surfaces. All of the resulting water, fill, and concrete concentrations and dose calculations are identical to those described for the contaminated basement surfaces in Section 6.6.1.

The “Activated Concrete/Rebar”spreadsheet is provided in Table 6-5, which lists the unitized dose factors for all radionuclides in the activated concrete mixture assuming a unit inventory of 1 pCi/g total activity at the surface of activated concrete.

Table 6-5
Activated Concrete Unitized Dose Factors 1.0 pCi/g

Key Parameters

Porosity	0.30		Bulk Density	1.50	g/cm^3	Yearly Drinking Water	478.00	L/yr
Wall Surface Area	4182.0	m^2	Fill Volume	2460.00	m^3	Surface Area/Open Volume	1.70	m^2/m^3
Concrete Volume	4.18	m^3	Concrete Density	2.20	g/cm^3	Annual Total Well Water Vol	738.00	m^3
Irrigation Rate	0.274	L/m^2-d	Surface Soil Depth	0.15	m	Activated Concrete Total Inventory	3.43E+08	Total pCi per pCi/g

DOSE CALCULATION FACTORS				SOURCE TERM			Kd		WATER, FILL, CONCRETE CONCENTRATION				CONTAMINATED CONCRETE ANNUAL DOSE				
Nuclide	NUREG-1727 mrem/y per pCi/g	FGR 11 mrem/ pCi	Mcroshield mrem/y per pCi/g	Nuclide Fraction	Inventory pCi/g	Inventory pCi	Kd Fill cm³/gm	Kd Concrete cm³/gm	Adsorption Factor	Water pCi/L	Fill pCi/g	Concrete pCi/g	Nuclide	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Cs-134	4.39E+00	7.33E-05	6.09E-05	4.00E-03	4.00E-03	1.37E+06	5.60E+01	3.00E+00	2.81E+02	6.62E-03	3.70E-04	1.98E-05	Cs-134	2.32E-04	1.29E-05	2.26E-08	2.45E-04
Co-60	6.58E+00	2.69E-05	6.30E-04	4.00E-02	4.00E-02	1.37E+07	1.30E+01	1.00E+02	6.71E+01	2.76E-01	3.59E-03	2.76E-02	Co-60	3.55E-03	8.09E-04	2.26E-06	4.37E-03
C-14	2.08E+00	2.09E-06	0.00E+00	5.80E-02	5.80E-02	1.99E+07	5.00E+00	1.00E+02	2.72E+01	9.89E-01	4.95E-03	9.89E-02	C-14	9.88E-04	9.15E-04	0.00E+00	1.90E-03
Eu-154	3.13E+00	9.55E-06	3.10E-04	9.00E-03	9.00E-03	3.09E+06	4.00E+02	0.00E+00	2.00E+03	2.09E-03	8.36E-04	0.00E+00	Eu-154	9.54E-06	2.90E-06	2.59E-07	1.27E-05
Fe-55	2.50E-03	6.07E-07	0.00E+00	1.24E-01	1.24E-01	4.25E+07	2.50E+01	1.00E+02	1.27E+02	4.53E-01	1.13E-02	4.53E-02	Fe-55	1.31E-04	5.03E-07	0.00E+00	1.32E-04
H-3	2.27E-01	6.40E-08	0.00E+00	6.47E-01	6.47E-01	2.22E+08	0.00E+00	0.00E+00	1.00E+00	3.00E+02	0.00E+00	0.00E+00	H-3	9.18E-03	3.03E-02	0.00E+00	3.95E-02
Eu-152	2.87E+00	6.48E-06	2.09E-04	1.11E-01	1.11E-01	3.81E+07	4.00E+02	0.00E+00	2.00E+03	2.58E-02	1.03E-02	0.00E+00	Eu-152	7.99E-05	3.29E-05	2.16E-06	1.15E-04
Ni-63	1.19E-02	5.77E-07	0.00E+00	7.00E-03	7.00E-03	2.40E+06	1.20E+01	1.00E+02	6.21E+01	5.23E-02	6.27E-04	5.23E-03	Ni-63	1.44E-05	2.76E-07	0.00E+00	1.47E-05

6.6.3 Embedded Pipe

a. Conceptual Model

Embedded pipe includes pipes that are encased in the basement concrete walls or floors that will remain after demolition and remediation. The conceptual dose model is identical to that described for contaminated basement surfaces. However, analogous to activated concrete, the source term calculation includes the entire radionuclide inventory contained in all embedded piping, regardless of location. The entire inventory is assumed to be instantaneously released into the worst case 738 m^3 of basement water.

b. Unitized Dose Factors for Embedded Pipe

The total embedded pipe inventory is calculated assuming a unit contamination level of 1 dpm/100 cm^2 over the entire internal surface area of all embedded pipe remaining after decommissioning. A list of the embedded piping planned to remain after decommissioning is provided in Attachment 6-7. The internal surface area of the embedded piping is 172 m^2. Assuming a unit inventory of 1 dpm/100 cm^2 the total inventory was determined to be 7.75E+03 pCi.. The 7.77E+03 pCi inventory applies to each radionuclide at a "unit" concentration of 1 dpm/100 cm^2. Based on this value, an inventory was calculated and input into the spreadsheet developed for the contaminated basement surfaces. The spreadsheet inventory" column input was calculated by multiplying the pipe surface contamination level, in this case a unitized level of 1 dpm/100 cm^2, by the 7.75E+03 pCi unit inventory. This form facilitates the use of the spreadsheet in the total dose and DCGL calculations provided in Section 6.7. All of the resulting water, fill, and concrete concentrations, and dose calculations are identical to those described for the contaminated basement surfaces in Section 6.6.1.

The "Embedded Pipe" spreadsheet is provided in Table 6-6. The results represent the unit dose factors for embedded piping assuming a source term of 1 dpm/100 cm^2, for each radionuclide, on the internal surfaces of the pipe.

Table 6-6
Embedded Piping Unitized Dose Factors

Key Parameters

Porosity	0.30		Bulk Density	1.50	g/cm^3	Yearly Drinking Water	478.00	L/yr
Wall Surface Area	4182.0	m^2	Fill Volume	2460.00	m^3	Surface Area/Open Volume	1.70	m^2/m^3
Concrete Volume	4.18	m^3	Concrete Density	2.20	g/cm^3	Annual Total Well Water Vol	738.00	m^3
Irrigation Rate	0.274	L/m^2-d	Surface Soil Depth	0.15	m	Embedded Pipe Conversion Factor	7748.0	pCi per dpm/100 cm^2

DOSE CALCULATION FACTORS				SOURCE TERM		Kd		WATER, FILL, CONCRETE CONCENTRATION				CONTAMINATED CONCRETE ANNUAL DOSE				
Nuclide	NUREG-1727 mrem/y per pCi/g	FGR 11 mrem/ pCi	Mcroshield mrem/y per pCi/g	Inventory dpm/100 cm^2	Inventory pCi	Kd Fill cm^3/gm	Kd Concrete cm^3/gm	Adsorption Factor	Water pCi/L	Fill pCi/g	Concrete pCi/g	Nuclide	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Sr-90	1.47E+01	1.42E-04	0.00E+00	1.00E+00	7.75E+03	6.00E+00	1.00E+00	3.10E+01	3.39E-04	2.03E-06	3.39E-07	Sr-90	2.30E-05	2.21E-07	0.00E+00	2.32E-05
Cs-134	4.39E+00	7.33E-05	6.09E-05	1.00E+00	7.75E+03	5.60E+01	3.00E+00	2.81E+02	3.74E-05	2.09E-06	1.12E-07	Cs-134	1.31E-06	7.29E-09	1.27E-10	1.32E-06
Cs-137	2.27E+00	5.00E-05	1.20E-05	1.00E+00	7.75E+03	5.60E+01	3.00E+00	2.81E+02	3.74E-05	2.09E-06	1.12E-07	Cs-137	8.93E-07	3.77E-09	2.51E-11	8.97E-07
Co-60	6.58E+00	2.69E-05	6.30E-04	1.00E+00	7.75E+03	1.30E+01	1.00E+02	6.71E+01	1.56E-04	2.03E-06	1.56E-05	Co-60	2.01E-06	4.57E-08	1.28E-09	2.05E-06
Co-57	1.67E-01	1.18E-06	2.80E-08	1.00E+00	7.75E+03	1.30E+01	1.00E+02	6.71E+01	1.56E-04	2.03E-06	1.56E-05	Co-57	8.81E-08	1.16E-09	5.68E-14	8.92E-08
Fe-55	2.50E-03	6.07E-07	0.00E+00	1.00E+00	7.75E+03	2.50E+01	1.00E+02	1.27E+02	8.25E-05	2.06E-06	8.25E-06	Fe-55	2.39E-08	9.17E-12	0.00E+00	2.39E-08
H-3	2.27E-01	6.40E-08	0.00E+00	1.00E+00	7.75E+03	0.00E+00	0.00E+00	1.00E+00	1.05E-02	0.00E+00	0.00E+00	H-3	3.21E-07	1.06E-07	0.00E+00	4.26E-07
Ni-63	1.19E-02	5.77E-07	0.00E+00	1.00E+00	7.75E+03	1.20E+01	1.00E+02	6.21E+01	1.69E-04	2.02E-06	1.69E-05	Ni-63	4.65E-08	8.92E-11	0.00E+00	4.66E-08

6.6.4 Surface Soil

a. Conceptual Model

Surface soil includes all soil within the first 15 cm of the ground surface. The NRC screening values for soil from NUREG-1727, Table C2.3, are used for the unitized dose calculations Therefore, the conceptual model is identical to that described in NUREG-1727. The screening values include the dose from all pathways. The groundwater contribution to the screening value dose is negligible and is entered as zero. The screening values are used because they were specifically generated by NRC to be conservative calculations of the resident farmer dose and are recommended for use in NUREG-1727.

Verification Conditions (for Surface Soil Screening Values). NUREG-1727, NMSS Decommissioning Standard Review Plan, Appendix C, describes the justification necessary to allow direct use of these screening. Per the NUREG, the following conditions must be satisfied:

1. The initial residual radioactivity (after decommissioning) is contained in the top layer of the surface soil [that is, approximately 6 inches (15cm)].
2. The unsaturated zone and the groundwater are initially free of contamination.
3. The vertical saturated hydraulic conductivity at the specific site is greater than the infiltration rate.

The above conditions are satisfied for the Maine Yankee site.

Condition One. The direct use of these screening values is only for surface soil (approx. 6 inches). Section 6.6.5 calculated a dose from deep soil (that is, greater than 6 inches) separate from the use of the surface soil screening values. (See Section 6.6.5)

Condition Two. Maine Yankee does not use the surface soil screening values to address potential site groundwater contamination from H-3. H-3 presence in the groundwater and surface water is assumed based upon the highest measured readings and is covered by separate dose assessments. (See Sections 6.6.6 and 6.6.7)

Condition Three. The soils at Maine Yankee that are in areas currently containing nuclides elevated above background, and those soils that are planned to be used to fill the foundations are bank run sand and gravel. The Adams or Hinckley USDA Soil Series would provide the closest approximation. The minimum saturated vertical hydraulic conductivity of these soils is 0.001 cm/sec or 1.417 inches per hour. Average saturated hydraulic conductivity rates would be about 10 times this, or 14 inches per hour. Infiltration capacity is based on land cover type, antecedent moisture condition prior to a rainfall or snowmelt event, and the rate of water supply available for infiltration. The permanent water table at the Maine Yankee site in the area of interest is approximately elevation 10 to 15 feet above Mean Sea Level, indicating a distance of 6 to 11 feet from the existing ground surface to the average water table position. Therefore, this much of the sand fill will be unsaturated. Infiltration capacity is limited by the unsaturated hydraulic conductivity of the soil. The unsaturated hydraulic conductivity of the sand fill is typically from 1/10 to 1/100 of the saturated hydraulic conductivity. Precipitation rates rarely exceed one inch per hour in Maine. Therefore, because the typically expected maximum precipitation rate is less than the minimum saturated hydraulic conductivity, and because the fill is unsaturated for 6 or more feet down and unable to transmit water downward at a rate exceeding the saturated vertical hydraulic conductivity, infiltration rates in the fill must be less than the saturated vertical hydraulic conductivity.

Soil types on the Maine Yankee site are representative of those assumed in the soil screening model. These soil types include: silt loams derived from glaciomarine sediments, fine sandy loams derived from glacial till, and fill that has a wide textural variation. However, the primary fill in the immediate plant area is a sand or loamy sand. The silt loams are most typical over the undisturbed portions of the site. The exceptions are in the knoll and ridge areas where bedrock is exposed or shallow where the fine sandy loams predominate. Fill areas surrounding the plant buildings are sand or loamy sand. Fill areas north of the 345 KV yard tend to have a silt loam surface covering. The most likely foundation fill material will be bank run sand. (See Section 6.6.1d.)

b. Unitized Dose Factors for Surface Soil

The unitized dose factors are generated for each radionuclide directly from the NUREG-1727 screening values by converting the values to mrem/y per pCi/g. Table 6-7 provides the “Surface Soil” unitized dose spreadsheet. The results represent the dose from a unit source term if 1 pCi/g for each radionuclide in the soil mixture.

Table 6-7
Surface Soil Unitized Dose Factors 1.0 pCi/g Cs-137

Key Parameters:

Soil Depth 0.15 m

DOSE CALCULATION FACTORS		SOURCE TERM	SURFACE SOIL ANNUAL DOSE
Nuclide	**NUREG-1727 mrem/y per pCi/g**	**Soil pCi/g**	**Total Dose mrem/yr**
Cs-137	2.27E+00	1.00E+00	2.27E+00
Co-60	6.58E+00	1.00E+00	6.58E+00
H-3	2.27E-01	1.00E+00	2.27E-01
Ni-63	1.19E-02	1.00E+00	1.19E-02

6.6.5 Deep Soil

a. Conceptual Model

Deep soil is defined as soil at depths greater than 15 cm. A separate calculation is required for deep soil because the NRC soil screening values apply to the top 15 cm of soil only. The resident farmer is exposed to deep soil through the direct exposure pathway and groundwater. The deep soil could be brought to the surface at some time in the future through the activities of the resident farmer. Therefore, the deep soil concentration will be limited to the surface soil DCGL.

The conceptual model for deep soil assumes a 15 cm layer of uncontaminated soil for the purpose of calculating the additional direct radiation exposure. The 15 cm cover represents the layer of surface soil. The direct radiation from residual contamination in the top 15 cm soil layer was accounted for in the surface soil screening values. A very large volumetric source term was assumed, i.e., 48,500 m^3, for the purpose of conservatively determining the potential for groundwater contamination from deep soil. This is considered a bounding source term volume and essentially represents the entire volume of soil within the restricted area down to bedrock. After remediation and backfill, the actual remaining volume of deep soil with any significant contamination will be a very small fraction of 48,500 m^3.

b. Unitized Dose Factors for Deep Soil

Unitized dose factors were calculated using unit concentrations of each of the radionuclides in the soil mixture. The contribution from direct radiation was calculated using the Microshield code assuming a 15 cm cover and default values from DandD for indoor occupancy time (0.6571 y), outdoor occupancy time (0.1101 y), and external radiation shielding factor (0.5512). The Microshield output reports, deep dose direct radiation calculations, and resulting dose factors are provided in Attachment 6-8.

The maximum groundwater concentrations were calculated using RESRAD and unit concentrations of each radionuclide in the mixture. The RESRAD groundwater parameters used in the analysis are listed in Table 6-8. Only the parameters pertaining to groundwater transport are listed since the groundwater concentration is the only RESRAD output used. The RESRAD parameters affecting groundwater transport were reviewed by a local hydrologist who is very familiar with the site hydrogeological characteristics (Mr. Robert Gerber, P.E. and Certified Geologist). The parameters in Table 6-3 are recommended site-specific values. The Kd’s were derived from Maine Yankee analyses of Bank Run Sand and Bank Run Gravel. The average of these two materials was assumed to represent the material used to backfill the site during plant construction. Finally, site-specific effective porosity was identified as variable at the site. To account for this variability, a sensitivity analysis was conducted over a range of 0.01 to 0.001. The highest groundwater concentration resulted from a value of 0.01, which was used in the analysis.

Table 6-8
Site Specific Parameters used in RESRAD Deep Soil Analysis

Parameter		Value	Units
Contam. Zone site specific hydraulic conductivity		32	m/y
Contam. Zone site specific b factor		4.05	
Site Specific Effective Porosity		0.01	
Unsat. Zone Site Specific Hydraulic Conductivity		1000	m/y
Site Specific Soil Kds:	Co	9.4	cm3/g
	Sr	4.4	cm3/g
	Cs	34.6	cm3/g
	Ni	8.0	cm3/g

Attachment 6-9 provides the RESRAD output report. The attachment provides the results for the radionuclides that were projected to migrate to groundwater over a 1000 year period. The RESRAD code was used only to estimate maximum groundwater concentrations, not calculate dose. The dose from the groundwater concentrations listed in Attachment 6-9 were calculated using the same parameters as in the water dose calculations performed for contaminated basement surfaces, activated concrete/rebar, and embedded piping, i.e, 478 l/y annual water intake and FGR 11 Dose Factors. The spreadsheet output and the unitized dose factors for deep soil are provided in Table 6-9.

6.6.6 Groundwater

This calculation applies to existing groundwater only. As described above, there are additional contributions to the projected total groundwater dose from other contaminated materials.

Groundwater dose is calculated directly from the highest individual groundwater sample result from site monitoring well locations. As reported in Section 2, Attachment B, the only radionuclide identified in site groundwater is H-3 and the maximum concentration was identified in the containment foundation sump at a concentration of 6812 pCi/l. The range of H-3 concentrations identified during characterization sampling of site wells was 441 pCi/l to 6812 pCi/l, for the most part consistent with background levels. The containment sump was re-sampled during continued characterization with 900 pCi/l H-3 identified. In addition, routine containment sump water samples have been collected since February 2000. None of these samples have exceeded the MDC level of about 2500 pCi/l.

In general, it appears that current containment sump H-3 water concentrations are within the range expected in area water background. However, to ensure that a conservative water concentration is applied and to avoid the potentially extensive sampling and analyses necessary to demonstrate that the concentrations are at background levels, the 6812 pCi/l H-3 concentration is used in the dose assessment. If, prior to unrestricted release of the site, additional groundwater monitoring data are collected that indicate higher H-3 concentration, or identify other radionuclides, the higher concentrations will be used in the final dose assessment for demonstrating compliance with the 10/4 mrem/yr dose limit.

Table 6-9
Deep Soil Unitized Dose Factors

Key Parameters

Porosity	0.30		Bulk Density	1.6	g/cm^3	Yearly Drinking Water	478.00	L/yr
Irrigation Rate	0.274	L/m^2-d	Surface Soil Depth	0.15	m			

DOSE CALCULATION FACTORS				SOURCE TERM		DEEP SOIL ANNUAL DOSE			
Nuclide	NUREG-1727 mrem/y per pCi/g	FGR 11 mrem/pCi	Mcroshield mrem/y per pCi/g	Deep Soil Inventory pC/gi	Water Inventory pCi/L per pCi/g	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Cs-137	2.27E+00	5.00E-05	4.00E-01	1.00E+00	1.10E+00	2.63E-02	1.04E-03	4.00E-01	4.27E-01
Co-60	6.58E+00	2.69E-05	2.40E+00	1.00E+00	6.60E-01	8.49E-03	1.81E-03	2.40E+00	2.41E+00
H-3	2.27E-01	6.40E-08	0.00E+00	1.00E+00	7.10E+03	2.17E-01	6.72E-01	0.00E+00	8.89E-01
Ni-63	1.19E-02	5.77E-07	0.00E+00	1.00E+00	9.40E+01	2.59E-02	4.66E-04	0.00E+00	2.64E-02

There are no unit dose factors or DCGLs for groundwater. The actual dose from the highest measured concentration will be used in the total dose calculation. The groundwater dose is calculated using the FGR 11 DCF for H-3 and a 478 l/y intake. The resulting dose is 0.21 mrem/y. The method for factoring the groundwater dose into the total dose calculation and the DCGL determination for other contaminated materials is described in Section 6.7.

The dose calculation for existing groundwater is provided below.

$$Dose_{GW} = (6812 \text{ pCi/l H-3})(478 \text{ l/y})(6.4E\text{-}08 \text{ mrem/y/pCi}) = 0.21 \text{ mrem/y} \quad (12)$$

6.6.7 Surface Water

Site surface water from the Fire Pond and Reflecting Pond was sampled during characterization. The results indicated no plant derived radionuclides in the Fire Pond and a low potential in the Reflecting Pond. Therefore, only the Reflecting Pond was considered in the dose assessment.

Tritium was detected in the Reflecting Pond at a maximum concentration of 960 pCi/l. This activity is not believed to be attributable to Maine Yankee operations. However, a review of available literature on H-3 concentrations in surface water could not conservatively demonstrate that the H-3 concentrations identified were consistent with background levels in the region. Additional characterization and literature review may provide the information needed to demonstrate that the H-3 was not plant derived. However, given the very low dose from these H-3 concentrations, it was not considered cost effective to perform more analyses.

As for groundwater, the dose from surface water was calculated using existing data. The maximum H-3 concentration of 960 pCi/l was used. As with groundwater, if higher concentrations or additional radionuclides are identified at any time prior to unrestricted release of the facility, the higher concentrations will be used in the final dose assessment for demonstrating compliance.

The surface water dose results from drinking water and ingesting fish from the pond. The water dose is calculated using the parameters described above assuming that the resident farmer drinks directly from the surface water source. The dose from fish ingestion is calculated using a water to fish transfer factor of 1 for H-3 (NUREG-5512, Vol. 3, Table 6.30), 20.6 kg fish consumption per year (DandD default value), and using DCFs from FGR No.11.

The calculations for water and fish consumption from onsite surface water with a H-3 concentration of 960 pCi/l is provided below.

$$Dose_{SW} = (960\ pCi/l\ H\text{-}3)(478\ l/y)(6.4E\text{-}08\ mrem/y/pCi) = 2.9E\text{-}02\ mrem/y \tag{13}$$

$$Dose_{Fish} = (960\ pCi/l)(1.0\ pCi/kg\ per\ pCi/l)(20.6\ kg/y))(6.4E\text{-}08\ mrem/y/pCi) = 1.3E\text{-}03\ mrem/y \tag{14}$$

6.6.8 Buried Piping/Conduit

a. Conceptual Model

After decommissioning is completed, some piping and conduit will remain underground at depths greater than three feet below grade. This contaminated material category includes the piping and conduit buried in open land, not pipe embedded in concrete basements, which were described in Section 6.6.3. A list of the buried piping/conduit that current plans call to remain after decommissioning is provided in Attachment 6-10. The buried piping/conduit is expected to contain very limited levels of contamination, if any. The radionuclide mixture is assumed to be the same as for contaminated materials.

The conceptual dose model for the buried piping/conduit is very simple and conservative. The piping/conduit is assumed to be uniformly contaminated over the entire internal surface area. The piping is further assumed to eventually disintegrate resulting in the total inventory in the pipe mixing with a volume of soil equal to the pipe volume. Without the assumption of the pipe disintegrating, there is essentially no dose pathway from buried piping/conduit. The resulting calculated soil concentrations are treated as deep soil and the dose was calculated using the same methods as described above for deep soil. However, the direct exposure is calculated assuming a three foot cover as opposed to a 15 cm cover. Although not required by the conceptual model, the buried piping/conduit DCGLs will be limited to ensure that the projected soil concentrations are below the surface soil DCGLs. This additional measure of conservatism was also applied to deep soil to account for hypothetical future excavation of the buried contamination.

b. Unitized Dose Factors for Buried Piping/Conduit

The total surface area and total volume were calculated for all of the buried piping/conduit planned to remain after decommissioning. Assuming a unit inventory of 1 dpm/100 cm^2 on the internal surfaces, the total inventory of each radionuclide was determined. This total inventory was divided by the total volume and converted to grams of soil assuming a density of 1.6 g/cm^3 to calculate the projected pCi/g soil concentration of each radionuclide. The list of Buried Piping/Conduit and the calculation of projected pCi/g soil concentration are provided in Attachment 6-10. The resulting concentration is 2.59E-04 pCi/g.

The resulting projected pCi/g soil concentration was entered as the source term in RESRAD for each applicable radionuclide. The RESRAD analysis was performed using the same parameters used for deep soil (Table 6-8) with the exception of the source term geometry. For the buried piping/conduit, the source term geometry was assumed to be a 142 m^2 area 1 m deep. This corresponds to the total volume of all buried piping/conduit of 142 m^3. This is a conservative assumption since, in reality, the piping is distributed over a fairly large surface area which would result in dilution through groundwater transport compared to the maximum concentration assuming all the pipe is contiguous. The RESRAD output report is provided in Attachment 6-11.

Microshield runs were performed on the unit source term assuming the same 142 m^2 x 1m deep source. The source is assumed to be covered by three feet of soil. The resulting exposure rate was multiplied by the default outdoor occupancy time (0.1101 y) from DandD, Version 1. The Microshield reports and Buried Piping/Conduit Direct Radiation Dose Factors are provided in Attachment 6-12.

The spreadsheet output and resulting unitized dose factors (1 dpm/100 cm^2) for buried piping/conduit are provided in Table 6-10.

Table 6-10
Buried Pipe and Conduit Unitized Dose Factors

Key Parameters

Porosity	0.30		Bulk Density	1.6	g/cm^3	Yearly Drinking Water	478.00	L/yr
Irrigation Rate	0.274	L/m^2-d	Surface Soil Depth	0.15	m	Buried Pipe CF	2.59E-04	pCi/g per dpm/100 cm^2

DOSE CALCULATION FACTORS				SOURCE TERM			DEEP SOIL ANNUAL DOSE			
Nuclide	FGR 11 mrem/pCi	NUREG-1727 mrem/y per pCi/g	Mcroshield mrem/y per pCi/g	Water Inventory pCi/L per pCi/g	Pipe Surface Inventory dpm/100cm^2	Soil Inventory pC/gi	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Sr-90	1.42E-04	1.47E+01	0.00E+00	3.69E+00	1.00E+00	2.59E-04	6.49E-05	5.85E-06	0.00E+00	7.07E-05
Cs-134	7.33E-05	4.39E+00	2.21E-05	0.00E+00	1.00E+00	2.59E-04	0.00E+00	0.00E+00	5.72E-09	5.72E-09
Cs-137	5.00E-05	2.27E+00	3.97E-06	1.02E-03	1.00E+00	2.59E-04	6.31E-09	2.50E-10	1.03E-09	7.59E-09
Co-60	2.69E-05	6.58E+00	2.53E-04	2.96E-03	1.00E+00	2.59E-04	9.86E-09	2.10E-09	6.55E-08	7.75E-08
Co-57	1.18E-06	1.67E-01	9.44E-09	3.39E-20	1.00E+00	2.59E-04	4.95E-27	6.11E-28	2.45E-12	2.45E-12
Fe-55	6.07E-07	2.50E-03	0.00E+00	0.00E+00	1.00E+00	2.59E-04	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	6.40E-08	2.27E-01	0.00E+00	1.61E+02	1.00E+00	2.59E-04	1.28E-06	3.94E-06	0.00E+00	5.22E-06
Ni-63	5.77E-07	1.19E-02	0.00E+00	2.80E+00	1.00E+00	2.59E-04	2.00E-07	3.60E-09	0.00E+00	2.04E-07

6.6.9 Forebay Sediment

The forebay consists of a water-filled canal which is lined on both sides by rip-rap dikes and runs from the circulating water pipe discharge point to the inlet of the diffuser pipes. The bottom of the forebay is bare rock. The forebay area is part of the liquid effluent release pathway.

Initial Site Characterization reported positive sample results for forebay sediment with Co-60 in the range of 0.04 to 11.2 pCi/g and Cs-137 in the range of less than MDA to 0.53 pCi/g. Attempts were made to collect additional samples of sediment from the forebay. The bottom appeared to be free of sediment and no sample material could be obtained. Small amounts of sediment were however present between the rip-rap at low tide. The lack of significant volumes of sediment in the forebay is not unexpected since the flow through the forebay during plant operations exceeded 400,000 gpm. Due to the small volumes and geometry, the dose from forebay sediment is expected to be very low.

A total of fifteen additional characterization samples were collected between the rip-rap from the sides and the north end of the forebay. The fifteen samples were combined into a single composite and analyzed for HTD and gamma emitting radionuclides. The results showed Co-60 at 31.7 pCi/g, Fe-55 at 13.6 pCi/g, Ni-63 at 8.9 pCi/g, Cs-137 at 1.2 pCi/g and Sb-125 at 0.4 pCi/g.

Since small volumes of contamination were identified between the rip-rap, the dose from this contamination was evaluated. The dose assessment assumes an individual stands or randomly walks over the rip-rap. Performing the dose assessment assuming the rip-rap remains in place is a conservative scenario. If the rip-rap is excavated or disturbed in some way, the small amount of contamination that is present will be mixed within the excavated volume and diluted.

The assessment assumes an inch of sediment uniformly distributed under all of the rip-rap. This appears to be a conservative source term assumption based on the characterization results to date. The rip-rap was assumed to be 2 foot diameter rock spheres. This assumption will be confirmed or modified after the additional characterization is completed.

The pathways evaluated were direct exposure and ingestion of the sediment. Inhalation was not considered a credible pathway because the material is submerged a portion of the time and essentially always remains damp. The resulting dose rate from the rip-rap sediment was compared to the dose from deep soil and surface soil combined. The soil concentrations were assumed to be equal to the DCGL.

The dose to the resident farmer will not be increased by the contamination in the forebay sediment if the dose rate from the rip-rap sediment is less than the dose rate from the soil. This is based on the assumption that the person will be located either on the soil or on the rip-rap, but not at both locations at the same time.

Therefore, the outdoor occupancy time is split between the soil area and the rip-rap area.

A detailed description of the forebay sediment dose assessment is provided in Attachment 6-16. The dose rates from the forebay sediment and soil were 2.3E-04 mrem/h and 2.0E-03 mrem/h, respectively. The soil dose rate was over 8 times higher than the forebay dose rate. Based on these data, the forebay sediment could be present at concentrations over 8 times higher than concentrations identified during characterization to date and not result in additional dose to the resident farmer. If additional characterization and final survey do not identify rip-rap sediment concentrations that result in dose exceeding the resident farmer soil dose, no remediation of the forebay rip-rap sediment will be performed.

Additional sediment characterization samples were obtained in May and June 2001. Locations sampled included the high and low tide areas of both east and west dikes, inside the weir area, the emergency spillway, and the forebay central area under water. An evaluation of the sediment depth and counting data is currently underway. The impact of this latest characterization effort on the forebay sediment dose assessment (described above), remediation plans, and FSS approach will be reported in a later LTP revision.

6.6.10 Circulating Water Pump House

The circulating water pump house (CWPH) was the intake for the plant circulating water (CW) system. The water intake was directly from the Back River at high volumes (about 400,000 gpm). The CWPH will be demolished to three feet below grade, backfilled, and stabilized on the river side with rock rip-rap. The intake structure which is below water level will remain in communication with the river. The contamination potential in this structure is very low.

There are three, albeit low potential, exposure pathways from the material that will remain in the demolished and backfilled CWPH: (1) exposure to radionuclides that have leached to the tidal water that saturates the remaining backfilled structure, (2) exposure from the excavation of the limited amount of silt currently on the bottom of the pump house bays, and (3) exposure from contamination that leaches from the structure surfaces, is adsorbed onto fill material, and is excavated at some time in the future.

Exposure to the excavated silt is limited to the same pathways as surface soil. Therefore, the DCGL for the silt will be the same as calculated for surface soil. In addition, the radionuclide mixture is assumed to be the same as that identified for surface soil. This assumption has essentially no effect since the samples will be counted by gamma spectroscopy, which will specifically identify the radionuclides of concern. Limiting the silt DCGL to the surface soil DCGL ensures that there will be no additional dose to the resident farmer, above that already accounted for through the surface soil DCGL, from the hypothetically excavated silt.

The potential for radionuclide leaching from the surfaces of the CWPH is very remote considering the extremely low potential of contamination being present as a result of past operations and the fact that if contamination were present from past operations, the constant tidal flushing of the pump house bays would have already removed any leachable material. Notwithstanding this low potential, one water sample will be collected from each of the four pump house bays prior to draining the bays for final survey. The analytical detection sensitivity will be at the environmental LLD level. If no activity is detected, the water leaching pathway will be eliminated from consideration. Potential leaching to water will be evaluated by direct water sampling only.

If activity above the environmental LLD is detected in the water samples, the positive results will be used to evaluate exposure from fish ingestion using the bioaccumulation factors from NUREG-5512, Vol. 3, Table 6.30, i.e., 20.6 kg fish consumption per year (DandD default value), and DCFs from FGR No.11. If a dose calculation is necessary, the dose will be added to the total dose from the other contaminated materials listed in Table 6-11. Adjustments will be made to the DCGL's for other contaminated materials, if necessary, to ensure compliance with the 10/4 mrem/yr unrestricted use criteria.

Since potential leaching into water is accounted for by direct water sampling, the only remaining exposure pathway to consider is the excavation of fill material hypothetically contaminated by radionuclide transfer from structure surfaces to the fill. The conceptual model developed for the contaminated basement surfaces is adequate to apply to this very low potential pathway. As shown in Attachment 6-13, the DCGL for building basements in Table 6-11 resulted in very low radionuclide concentrations on the basement fill, with all concentrations being less than 1 pCi/g. Note that one of the criteria applied to the selection of the basement fill DCGL is that the calculated fill concentration be less than the surface soil DCGL. In addition, the Kd's used for the basement fill model (Bank Run Sand) are generally higher than the Kd's for Bank Run Gravel which is being considered for backfill. This indicates that the CWPH fill would have lower concentrations than those calculated for basement fill. However, regardless of the fill material used, it is unlikely that the fill concentration would exceed the surface soil DCGL.

Considering all of the arguments presented above, the DCGL calculated for the building basements is appropriate and conservative for application to CWPH surfaces for the purpose of limiting hypothetical dose from the excavated fill pathway (as stated above, the potential leaching to water is addressed by direct sampling of the water). Compliance with the basement fill DCGL will ensure that the fill concentration will not exceed the surface soil DCGLs. Since the concentration of the hypothetically excavated fill would be below the surface soil DCGLs, there will be no additional dose to the resident farmer beyond that already accounted for through the surface soil and no addition to the total dose calculated in Table 6-11 is necessary.

6.7 Material Specific DCGLs and Total Dose Calculation

As described above, calculations were performed to develop conservative dose assessment models and generate unitized dose factors for all contaminated materials at the Maine Yankee site and all radionuclides in the Maine Yankee mixture applicable to each material. When the dose pathways for the resident farmer were evaluated, it was evident that the resident farmer could receive dose from more than one contaminated material. A detailed discussion of the various contaminated materials and dose pathways was provided above. The total dose results from the summation of the contributions from each of contaminated materials. Therefore, the final DCGLs for each of the contaminated materials are inter-dependent.

This section describes the method used to account for the dose from all materials and select the final DCGLs for all materials. The method ensures that the summation of doses from all pathways, at the selected DCGL concentrations for all materials, does not exceed 4 mrem/y drinking water dose and 10 mrem/y total dose. Table 6-11 provides the DCGLs that were selected for the Maine Yankee Site and the resulting total dose for all contaminated materials. Attachment 6-13 contains the dose calculations for all contaminated materials listed in Table 6-11. The radionuclide mixture for the containment annulus trench differs from the rest of the basement surfaces. Therefore, a separate DCGL was selected and a separate dose calculation was performed for the trench.

The DCGLs listed in Table 6-11 are target project DCGLs. The formal unrestricted use criteria are the enhanced State dose criteria of 10 mrem/y or less from all pathways and 4 mrem/y or less from groundwater drinking sources. The DCGL values in Table 6-11 may be adjusted as the project proceeds using the methods and limitations described in this section as long as the dose criteria are satisfied.

Table 6-11
Contaminated Material DCGL

Basement Contaminated Concrete (gross beta dpm/100 cm^2):	18,000.00
Note: Annulus Trench Concrete DCGL = 9,500 (gross beta dpm/100 cm^2)	
Basement Activated Concrete (pCi/g):	1.00
Surface Soil (Cs-137 pCi/g):	3.00
Deep Soil (Cs-137 pCi/g):	3.00
Embedded Piping, (gross beta dpm/100 cm^2):	18,000.00
Ground Water (H-3, pCi/L):	6812.00
Surface Water (H-3, pCi/L):	960.00
Buried Piping, Conduit and Cable, (gross beta dpm/100 cm^2):	9,800.00

Contaminated Material Annual Dose

Material	Drinking Water (mrem/y)	Direct, Inhalation & Ingestion (mrem/y)	Total Annual Dose (mrem/y)
Contaminated Concrete	5.00E-01	5.63E-02	5.56E-01
Activated Concrete	1.42E-02	3.21E-02	4.63E-02
Surface Soil	0.00E+00	7.05E+00	7.05E+00
Deep Soil	1.22E-01	1.95E+00	2.07E+00
Embedded Piping	2.05E-02	2.34E-04	2.08E-02
Ground Water	2.08E-01	0.00E+00	2.08E-01
Surface Water	2.94E-02	1.27E-03	3.06E-02
Buried Piping, Conduit & Cable	4.56E-03	1.83E-03	6.40E-03
Total	0.90 mrem/y	9.09 mrem/y	9.99 mrem/y

The dose summation method is a conservative screening approach. For example, the environmental pathway analysis for deep soil indicated that a low concentration of tritium would reach groundwater three years after the site is released for unrestricted use. The location of the deep soil and corresponding groundwater contamination are obviously different from the location of building basements where the hypothetical resident farmer well was placed. In addition, the peak time for H-3 water concentration from deep soil is different from the peak time for the basement water concentration. Nonetheless, consistent with a screening approach, the peak H-3 concentration in groundwater from deep soil is fully added to the peak basement water concentration and the sum is used in the dose assessment. There was no reduction in concentration due to the differences in peak dose time or dilution through groundwater transport. A more realistic and less conservative environmental pathway analysis would consider these effects.

The Maine Yankee commitment to a conservative screening approach is also seen in the methods for adding the dose contributions from embedded piping, activated concrete/rebar, and contaminated surfaces in the building basements, as well the other contaminated materials. It is important to recognize that the conservative results from the dose summation are in addition to the conservatism already built into the unitized dose factor calculations for the individual contaminated materials.

Soil areas outside of the RA boundary will not require consideration of dose from any other materials. The area of the RA is approximately 10,000 m^2, which represents the size of the resident farmer survey unit and contains the other contaminated materials considered. The other contaminated materials have essentially no effect outside of the RA and the dose is assumed to result from the contaminated soil only. In this case, the DCGLs will be based on the NUREG-1727 screening values corrected to represent 10 mrem/y. The soil radionuclide mixture applied to areas outside the RA boundary are assumed to be the same as the mixture listed in Table 6-13 in Attachment D.

6.7.1 Conceptual Model for Summing Contaminated Material Dose

The conceptual model for summing doses to the resident farmer essentially combines the dose from surface soil and deep soil with the dose from water derived from a well drilled directly into the worst case building basement. The well water is used for irrigation and drinking.

The source term for the well water concentrations includes contributions from basement contamination, activated concrete/rebar, and embedded piping. The model assumes that the residual contamination in all three materials is instantaneously released and mixed with water that has infiltrated the building basement.

The instantaneous release of all contamination is conservative for several reasons. Concrete contamination will be released at a rate associated with the diffusion coefficient for the various radionuclides. Activated concrete/rebar will actually be released to the water at a relatively slow rate more closely linked to physical dissolution of concrete, which is expected be very slow. For embedded piping, the actual contamination release rate is expected to be close to zero because any open pipe end that could be a point of release into a basement will be sealed. Another conservatism is the assumption that all of these sources are mixed in the same worst case 2460 m^3 of basement volume. In actuality, the various sources are in different areas and different buildings. Finally, the source term contributions from groundwater, surface water, and deep soil were added directly to the basement well concentrations without consideration of transport or dilution.

6.7.2 Method and Calculations for Summing Contaminated Material Dose

The primary inputs to the dose summation are the unitized dose factor calculations developed for each contaminated material. The unitized dose spreadsheets were used for the dose calculations without modification. However, the input concentrations and inventories required modification to represent the selected DCGLs as opposed to unit concentrations. The additional calculations required to convert the DCGL values into radionuclide concentrations and inventories are described in the sections below.

To perform the summation and to provide a method to efficiently adjust the DCGLs for various materials, each of the individual material unitized dose spreadsheets was copied and linked in a single spreadsheet entitled DCGL/Total Dose. The spreadsheet output for the DCGL dose calculation for each material is provided in Attachment 6-13. These spreadsheets provide the calculations for the dose values reported in Table 6-11.

Contaminated Basement Surfaces

The DCGL for contaminated concrete is expressed as dpm/100 cm^2 detectable gross beta. This form was required because the final survey will be performed using gross beta measurements. The primary criteria for selecting the gross beta DCGL for basement surfaces was to ensure that the total dose, from all contaminated materials, was less than the 10/4 mrem/yr dose limit. There were two secondary criteria applied to the selection of the DCGL; 1) the DCGL would result in calculated basement fill concentrations below the surface soil DCGL, and 2) the DCGL was less than the NRC surface screening values from NUREG-1727, Table C2.2 (see Attachment 6-18).

To calculate the dose from a given gross beta DCGL, the gross beta concentration is converted to individual radionuclide concentrations based on their respective fractions in the radionuclide mixture. The individual concentrations are then input to the dose calculation spreadsheet for contaminated basement concrete. Characterization data indicated that the radionuclide mixtures for the containment annulus trench differs from the other the basement surfaces (see Table 2-8). Therefore, a separate mixture is applied to the dose assessment for the annulus trench, resulting in a different DCGL for the trench. The DCGL selected for the annulus trench resulted in a lower dose than that calculated for the rest of the basement surfaces (see Attachment 6-13). Therefore, the total dose shown in Table 6-11 is based on the higher dose calculated for the general radionuclide mixture and DCGL, not the trench mixture.

The individual radionuclide concentrations are calculated as follows:

Convert the detectable gross beta concentration to total radionuclide concentration:

Total dpm/100 cm^2 = (gross beta dpm/100 cm^2)/(Ggross beta radionuclide fractions) (15)

Where: Total dpm/100 cm^2 is the summation of activity from all radionuclides
Gross beta is the detectable gross beta concentration
Ggross beta radionuclide fractions is the sum of the fractions of each radionuclide in the Maine Yankee mixture with detectable beta

Calculate each individual radionuclide concentration as follows:

C_R dpm/100 cm^2 = (NF_R)(Total dpm/100 cm^2) (16)

Where: C_R is the concentration of a given radionuclide
NF_R is the nuclide fraction of a given radionuclide

Surface Soil

The DCGL for surface soil is expressed in pCi/g Cs-137. The surface soil dose is calculated by first determining the individual radionuclide concentrations by ratio to Cs-137 using the relative fractions in the Maine Yankee mixture and then entering the individual concentrations into the “inventory” column in the dose calculation spreadsheet for surface soil.

The final survey and final site dose assessment will be based on gamma spectroscopy results of individual soil samples, radionuclide specific DCGLs based on NUREG-1727 screening values (corrected to 10 mrem/y), and a “unity rule” approach. The dose contributions from the other contaminated materials will be accounted for by comparing the “unity” summation to a dose corrected value. The dose corrected value will be calculated by dividing the surface soil dose in Table 6-11 by 10 mrem/y. However, the surface soil dose value may change if different DCGLs are ultimately selected for the remaining contaminated materials. In no case will the total dose from all materials exceed the State of Maine enhanced criteria.

During final survey, and in the final site dose assessment, the non-gamma emitting radionuclides will be accounted for using Cs-137 as a surrogate as described in Equation 17 (from NUREG-1505, Page 11-2, Equation 11-4). As seen in Attachment 6-13, the contribution from the HTD radionuclides in soil (Ni-63 and H-3) is less than 1% of the Cs-137 dose. Therefore, the effect of the surrogate calculation on the Cs-137 $DCGL_w$ value will be minimal.

To adjust ^{137}Cs for HTD: (17)

$$CS-137s=\frac{1}{\frac{1}{D_1}+\frac{R_2}{D_2}+\frac{R_3}{D_3}+\ldots+\frac{R_n}{D_n}}$$

Where: $Cs\text{-}137_s$ is the surrogate Cs-137 $DCGL_w$
R_n is the ratio of the HTD radionuclide mixture fraction to the Cs-137 mixture fraction
D_n is the $DCGL_w$ of the HTD radionuclide

The unitized dose factors were used in the total dose and DCGL calculations. This allowed the dose contribution of each radionuclide to be calculated and reviewed to understand the relative significance of the nuclides in the mixture. The dose calculated from the Cs-137 concentration shown in Table 6-11 will be the same regardless of whether a “surrogate” Cs-137 $DCGL_w$ is used or the unitized dose factors for all radionuclides are used.

The Cs-137 to Co-60 ratio will vary in the final survey soil samples and this will be accounted for using a “unity rule” approach as described previously. However, absent sample-specific information from the final survey, using the radionuclide mixture fractions to represent the final Cs-137/Co-60 ratios is the best method available to estimate dose and determine target soil concentrations for remediation planning.

Activated Concrete/Rebar

The DCGL for activated concrete/rebar is in units of pCi/g total activity at the wall and floor surfaces. Total activity includes all radionuclides in the Maine Yankee mixture. The target remediation concentration is 1 pCi/g of activated concrete. Therefore, no modification of the unit dose factor spreadsheet for activated concrete was required to account for the DCGL concentration.

Deep Soil

The DCGL for deep soil, as for surface soil, is expressed in pCi/g Cs-137. The deep soil dose is calculated by first determining the individual radionuclide concentrations by ratio to Cs-137 using the relative fractions in the Maine Yankee surface soil mixture and then entering the individual concentrations into the "inventory" column in the dose calculation spreadsheet for deep soil. The surface soil radionuclide mixture is assumed to be representative of the deep soil mixture.

The issues related to compliance using final survey results for gamma emitters and the use of Cs-137 as a surrogate for the HTD radionuclides that were described for surface soil also apply to deep soil.

Groundwater

The existing groundwater concentrations are entered directly into the DCGL/Total Dose spreadsheet. This allows the dose from current groundwater contamination to be accounted for. The entered concentration is not intended to be a DCGL. If Maine Yankee's estimate of existing groundwater concentration changes, the value(s) input to the final dose calculation for compliance with the 10/4 dose criteria will use the most applicable concentrations.

Surface Water

The maximum concentration identified was used in the dose assessment. As with the groundwater concentration, the entered concentration is not a DCGL. If new sample data, if collected, indicates higher concentrations in site surface water, the new data will be used in the final dose assessment to demonstrate compliance with the 10/4 dose criteria.

Buried Piping/Conduit

The buried piping/conduit DCGL is expressed as dpm/100 cm^2 gross beta. The DCGL/Total Dose spreadsheet converts gross beta concentration to individual radionuclide concentrations analogous to contaminated basement surfaces. The resulting concentrations are entered in the dpm/100 cm^2 inventory column in the dose calculation spreadsheet.

6.8 Area Factors

6.8.1 Basement Contamination

The basement contamination conceptual model described in Section 6.6.1 was based on a worst case surface area of 4182 m^2. The model assumes uniform mixing within a 0.6 m layer of fill in direct contact with the 4182 m^2.surface area. The conceptual model assumes that the activity released from the wall is mixed with the 738 m^3 volume of water contained in the 0.6 m fill layer, but does not require the contamination to be uniformly distributed over the entire 4182 m^2 surface area. The model source term is the total inventory over the surface and is not dependent on the distribution of the contamination on the surface. Therefore, consistent with the conceptual model, the area factor could be a simple linear relationship between total activity and area. The area factor formula would then be described using the following equation:

$$AF = 4182 \text{ m}^2/(\text{elevated area}) \qquad (18)$$

where: AF is the area factor
(elevated area) is the size of the area exceeding the $DCGL_W$

Maine Yankee evaluated this potential approach and believes that it is consistent with NUREG-1575 and NUREG-1727 guidance which acknowledges that the area factors should be based on the dose model used to calculate the DCGL. However, it appears that substantially better remediation performance can be achieved than is reflected in Equation (18) and that leaving elevated areas at the levels allowed by the equation is not sufficiently conservative. Accordingly, the area factors for contaminated basement concrete will be calculated using Equation (19), which represents a considerably more conservative approach.

$$AF = 50\ m^2/(\text{elevated area}) \tag{19}$$

where: AF is the area factor
(elevated area) is the size of the area exceeding the $DCGL_W$

The 50 m^2 area was selected after qualitative consideration of the potential residual contamination that could remain in elevated areas after a comprehensive remediation effort. Areas greater than 50 m^2 are required to be at or below the $DCGL_w$. Area factors can apply to elevated areas on any surface, but are expected to be applied primarily to contamination in cracks and crevices, or other geometries, that are not efficiently remediated. It is not expected that a large number of elevated areas will remain. The number of elevated areas allowed to remain is limited by the formula presented in Section 5.6.3.

6.8.2 Surface Soil and Deep Soil Area Factors

The NRC screening values were used to calculate the surface soil DCGLs. This approach does not provide a direct method of linking the area factor calculation to the dose model. The surface soil area factors were determined based on the change in direct radiation as a function of area. The relative exposure was determined using Microshield. The output reports are provided in Attachment 6-14.

Using direct radiation only is a conservative approach since area factors based on the ingestion and inhalation dose pathways increase at a faster rate than those based on the direct radiation pathway. This is evident from inspection of Table 5.6 in NUREG-1575 which shows, for example, the higher area factors for Am-241 as compared to Cs-137 and Co-60. The area factors for surface and deep soil are listed in Table 6-12.

Table 6-12
Area Factors for Surface Soil and Deep Soil
Survey Unit = 10,000 m^2

Area m^2	1	2	4	6	8	16	25	50	100	500	1,000	10,000
Area Factor	12.0	6.8	4.1	3.2	2.8	2.0	1.7	1.5	1.3	1.2	1.1	1.0

6.9 Standing Building Dose Assessment and DCGL Determination

6.9.1 Dose Assessment Method

This dose assessment applies to the occupancy of a standing building and does not apply to the filled building basement. Current plans call for only one building to remain standing after decommissioning, i.e., the switchyard relay house. The NRC screening values from NUREG-1727, Table C2.2 were used for building occupancy dose assessment and DCGL determination. The screening values were adjusted to correspond to 10 mrem/y.

NUREG-1727, NMSS Decommissioning Standard Review Plan, Appendix C, describes the justification necessary to allow direct use of these screening values. When using the screening approach licensees need to demonstrate that the particular site conditions (e.g., physical and source term conditions) are compatible and consistent with the DandD model assumptions.

The following site conditions are specified for use of the Standing Building screening values:

1. The contamination on building surfaces (e.g., walls, floors, ceilings) should be surficial and non-volumetric (e.e., less than 0.4 in (10 mm)).
2. Contamination on surfaces is mostly fixed (not loose), with the fraction of loose contamination not to exceed 10 percent of the total surface activity.
3. The screening criteria are not applied to surfaces such as buried structures (e.g., drainage or sewer pipes) or mobile equipment within the building; such structures and buried surfaces will be treated on a case-by-case basis.

The above conditions are satisfied for the Maine Yankee site.

6.9.2 Standing Building DCGLs

The standing building DCGL was calculated as shown in Table 6-13. The DCGLs were calculated using Equation 4-4 in NUREG-1727 as adjusted for gross beta by multiplying the results by the gross beta radionuclide fraction in the mixture. The DCGL was expressed as gross beta since the final survey of a standing building, if necessary, will be performed using gross beta measurements.

6.9.3 Standing Building Area Factors

As discussed above for soil, using the NRC screening values for DCGL determination does not allow for direct determination of area factors. Consistent with the method used for soil, Microshield runs were used to generate the area factors by starting with an area of 100 m^2 and calculating the relative exposure rate as the area is decreased. The ratio of the 100 m^2 exposure rate to the respective smaller area exposure rate represents the area factor for the given elevated area size. Attachment 6-15 contains the Microshield runs and Table 6-14 provides the resulting area factors.

Table 6-13
Gross Beta DCGL For Standing Buildings
(Not Applicable to Basements to be Filled)

Nuclide	Nuclide Fraction (*nf*)	Screening Level dpm/100 cm^2	Beta Fraction	*nf*/Screening Level
H-3	2.36E-02	4.96E+07		4.75E-10
Fe-55	4.81E-03	1.80E+06		2.67E-09
Co-57	3.06E-04	8.44E+04		3.63E-09
Co-60	5.84E-02	2.82E+03	5.84E-02	2.07E-05
Ni-63	3.55E-01	7.28E+05		4.88E-07
Sr-90	2.80E-03	3.48E+03	2.80E-03	8.04E-07
Cs-134	4.55E-03	5.08E+03	4.55E-03	8.95E-07
Cs-137	5.50E-01	1.12E+04	5.50E-01	4.91E-05
		Sum	6.16E-01	7.20E-5
				DCGL 8.554E+03 *B* dpm/100 cm^2 (10 mrem/y)

Table 6-14
Area Factors for Standing Buildings
(Does Not Apply to Building Basements To Be Filled)
Survey Unit Size = 100 m^2

Area m^2	0.5	1	2	4	8	16	25	50	100
Area Factor	23.5	12.6	7.1	4.3	2.8	1.9	1.6	1.2	1.0

6.10 References

6.10.1 Baes, C.F., R.D. Sharp, A.L. Sjorren, and R.W. Shor, 1984. “A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture,” ORNL-5786, Oak Ridge National Laboratory.

6.10.2 U.S. Environmental Protection Agency, 1988. “External Exposure to Radionuclides in Air Water and Soil, Federal Guidance Report No. 11,” EPA 520/1-88-020, U. S. EPA Office of Radiation and Indoor Air.

6.10.3 Krupka, K.M., and R.J. Serne, 1998. “Effects on Radionuclide Concentrations by Cement/Ground-Water Interactions in Support of Performance Assessment of Low-Level Radioactive Waste Disposal Facilities,” NUREG/CR-6377, PNNL-14408.

6.10.4 Onishi, Y., R.J. Serne, R.M. Arnold, C.E. Cowan, and F.L. Thompson, 1981. “Critical Review: Radionuclide Transport, Sediment Transport, and Water Quality Mathematical Modeling; and Radionuclide Adsorption/Desorption Mechanisms,” NUREG/CR-1322, PNL-2901.

6.10.5 Sheppard, M.I. and D.H. Thibault, 1990. “Default Soil Solid/Liquid Partition Coefficients.”

Attachment 6-1
Fill Direct Dose Microshield Output

Basement Fill Direct Dose
Unitized Values

This attachment provides the Microshield outputs for direct dose factors for basement fill. The area size is 10,000 m2 by 5.8 m deep. Fill density is 1.5 g/cm3. The dose point is 1 meter above the soil surface. The shielded data assume 1 m of clean soil has been placed on top of the basement fill material. The dose factor assumes 964 hours exposure time per year.

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : SOILFL.MS5
Run Date : March 15, 2001
Run Time : 10:45:17 AM
Duration : 00:00:10

File Ref:
Date:
By:
Checked:

Case Title: Soil Fill
Description: Using the RESRAD land area approx.10000 m2
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	580.0 cm	19 ft 0.3 in
Width	1.0e+4 cm	328 ft 1.0 in
Height	1.0e+4 cm	328 ft 1.0 in

Dose Points

	X	Y	Z
# 1	780 cm	5000 cm	5000 cm
	25 ft 7.1 in	164 ft 0.5 in	164 ft 0.5 in

Shields

Shield Name	Dimension	Material	Density
Source	5.80e+10 cm³	SiO2	1.5
Shield 1	100.0 cm	SiO2	1.5
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	8.7000e-002	3.2190e+009	1.5000e-006	5.5500e-002
Cs-137	8.7000e-002	3.2190e+009	1.5000e-006	5.5500e-002

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Attachment 6-1

DOS File : SOILFL.MS5
Run Date: March 15, 2001
Run Time: 10:45:17 AM
Duration : 00:00:10

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	6.664e+07	2.688e-67	7.288e-28	2.239e-69	6.071e-30
0.0322	1.230e+08	3.170e-65	1.403e-27	2.551e-67	1.129e-29
0.0364	4.474e+07	2.967e-50	8.637e-28	1.686e-52	4.907e-30
0.6616	2.896e+09	1.398e-07	7.706e-06	2.711e-10	1.494e-08
TOTALS:	3.131e+09	1.398e-07	7.706e-06	2.711e-10	1.494e-08

Cs-137

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 10:45:17 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	2.114e-007	1.165e-005
Photon Energy Fluence Rate	MeV/cm²/sec	1.398e-007	7.706e-006
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.711e-010	1.494e-008
Absorbed Dose Rate in Air	mGy/hr	2.367e-012	1.304e-010
"	mrad/hr	2.367e-010	1.304e-008
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.802e-012	1.544e-010
o Opposed	"	2.244e-012	1.236e-010
o Rotational	"	2.244e-012	1.236e-010
o Isotropic	"	1.984e-012	1.093e-010
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.978e-012	1.641e-010
o Opposed	"	2.829e-012	1.559e-010
o Rotational	"	2.829e-012	1.559e-010
o Isotropic	"	2.121e-012	1.169e-010
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	2.478e-012	1.365e-010
o Posterior/Anterior	"	2.187e-012	1.205e-010
o Lateral	"	1.622e-012	8.936e-011
o Rotational	"	1.954e-012	1.077e-010
o Isotropic	"	1.664e-012	9.168e-011

Cs-134

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 10:47:42 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.411e-006	4.701e-005
Photon Energy Fluence Rate	MeV/cm²/sec	1.390e-006	4.050e-005
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.526e-009	7.528e-008
Absorbed Dose Rate in Air	mGy/hr	2.205e-011	6.572e-010
"	mrad/hr	2.205e-009	6.572e-008
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.539e-011	7.628e-010
o Opposed	"	2.134e-011	6.318e-010
o Rotational	"	2.134e-011	6.318e-010
o Isotropic	"	1.898e-011	5.604e-010
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.706e-011	8.132e-010
o Opposed	"	2.594e-011	7.774e-010
o Rotational	"	2.594e-011	7.774e-010
o Isotropic	"	2.019e-011	5.976e-010
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	2.273e-011	6.806e-010
o Posterior/Anterior	"	2.064e-011	6.127e-010
o Lateral	"	1.605e-011	4.694e-010
o Rotational	"	1.854e-011	5.493e-010
o Isotropic	"	1.618e-011	4.756e-010

Co-57

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 10:53:24 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	5.133e-010	2.688e-008
Photon Energy Fluence Rate	MeV/cm²/sec	3.520e-010	1.819e-008
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	6.800e-013	3.515e-011
Absorbed Dose Rate in Air	mGy/hr	5.936e-015	3.068e-013
"	mrad/hr	5.936e-013	3.068e-011
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	7.006e-015	3.624e-013
o Opposed	"	5.637e-015	2.913e-013
o Rotational	"	5.637e-015	2.913e-013
o Isotropic	"	4.984e-015	2.576e-013
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	7.458e-015	3.857e-013
o Opposed	"	7.091e-015	3.666e-013
o Rotational	"	7.091e-015	3.666e-013
o Isotropic	"	5.330e-015	2.755e-013
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	6.204e-015	3.209e-013
o Posterior/Anterior	"	5.492e-015	2.839e-013
o Lateral	"	4.091e-015	2.113e-013
o Rotational	"	4.909e-015	2.538e-013
o Isotropic	"	4.188e-015	2.164e-013

Co-60

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 10:46:39 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.904e-005	3.434e-004
Photon Energy Fluence Rate	MeV/cm²/sec	2.435e-005	4.366e-004
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	4.264e-008	7.655e-007
Absorbed Dose Rate in Air	mGy/hr	3.722e-010	6.683e-009
"	mrad/hr	3.722e-008	6.683e-007
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	4.224e-010	7.586e-009
o Opposed	"	3.641e-010	6.536e-009
o Rotational	"	3.641e-010	6.536e-009
o Isotropic	"	3.254e-010	5.839e-009
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	4.496e-010	8.075e-009
o Opposed	"	4.330e-010	7.776e-009
o Rotational	"	4.330e-010	7.776e-009
o Isotropic	"	3.446e-010	6.185e-009
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	3.804e-010	6.832e-009
o Posterior/Anterior	"	3.506e-010	6.295e-009
o Lateral	"	2.792e-010	5.008e-009
o Rotational	"	3.158e-010	5.668e-009
o Isotropic	"	2.796e-010	5.018e-009

Mn-54

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 11:04:04 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	9.506e-007	3.449e-005
Photon Energy Fluence Rate	MeV/cm²/sec	7.936e-007	2.879e-005
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.502e-009	5.448e-008
Absorbed Dose Rate in Air	mGy/hr	1.311e-011	4.756e-010
"	mrad/hr	1.311e-009	4.756e-008
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.523e-011	5.524e-010
o Opposed	"	1.257e-011	4.559e-010
o Rotational	"	1.257e-011	4.559e-010
o Isotropic	"	1.111e-011	4.030e-010
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.630e-011	5.914e-010
o Opposed	"	1.557e-011	5.647e-010
o Rotational	"	1.557e-011	5.647e-010
o Isotropic	"	1.189e-011	4.314e-010
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.358e-011	4.928e-010
o Posterior/Anterior	"	1.220e-011	4.426e-010
o Lateral	"	9.291e-012	3.370e-010
o Rotational	"	1.093e-011	3.963e-010
o Isotropic	"	9.419e-012	3.417e-010

5b-125

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 11:05:19 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.198e-008	4.227e-006
Photon Energy Fluence Rate	MeV/cm²/sec	3.724e-008	2.473e-006
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	7.255e-011	4.820e-009
Absorbed Dose Rate in Air	mGy/hr	6.333e-013	4.208e-011
"	mrad/hr	6.333e-011	4.208e-009
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	7.563e-013	5.038e-011
o Opposed	"	5.980e-013	3.969e-011
o Rotational	"	5.980e-013	3.969e-011
o Isotropic	"	5.288e-013	3.510e-011
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	8.007e-013	5.328e-011
o Opposed	"	7.588e-013	5.047e-011
o Rotational	"	7.588e-013	5.047e-011
o Isotropic	"	5.648e-013	3.749e-011
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	6.669e-013	4.439e-011
o Posterior/Anterior	"	5.848e-013	3.887e-011
o Lateral	"	4.291e-013	2.845e-011
o Rotational	"	5.220e-013	3.467e-011
o Isotropic	"	4.422e-013	2.935e-011

Pu-238

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 11:09:58 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	5.584e-026	2.808e-024
Photon Energy Fluence Rate	MeV/cm²/sec	3.088e-027	1.553e-025
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	6.890e-030	3.465e-028
Absorbed Dose Rate in Air	mGy/hr	6.015e-032	3.025e-030
"	mrad/hr	6.015e-030	3.025e-028
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.034e-031	5.202e-030
o Opposed	"	5.340e-032	2.686e-030
o Rotational	"	5.051e-032	2.540e-030
o Isotropic	"	4.944e-032	2.486e-030
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.032e-031	5.188e-030
o Opposed	"	7.038e-032	3.540e-030
o Rotational	"	7.038e-032	3.540e-030
o Isotropic	"	5.229e-032	2.630e-030
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	7.884e-032	3.965e-030
o Posterior/Anterior	"	5.515e-032	2.774e-030
o Lateral	"	3.257e-032	1.638e-030
o Rotational	"	4.650e-032	2.338e-030
o Isotropic	"	3.783e-032	1.903e-030

Pu-239

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 11:10:41 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.152e-016	4.535e-014
Photon Energy Fluence Rate	MeV/cm²/sec	1.301e-017	5.121e-015
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.013e-020	7.920e-018
Absorbed Dose Rate in Air	mGy/hr	1.757e-022	6.914e-020
"	mrad/hr	1.757e-020	6.914e-018
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.842e-022	1.118e-019
o Opposed	"	1.600e-022	6.294e-020
o Rotational	"	1.609e-022	6.331e-020
o Isotropic	"	1.535e-022	6.042e-020
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.830e-022	1.114e-019
o Opposed	"	2.263e-022	8.904e-020
o Rotational	"	2.263e-022	8.904e-020
o Isotropic	"	1.636e-022	6.439e-020
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	2.462e-022	9.688e-020
o Posterior/Anterior	"	1.947e-022	7.663e-020
o Lateral	"	1.205e-022	4.742e-020
o Rotational	"	1.662e-022	6.540e-020
o Isotropic	"	1.325e-022	5.216e-020

Pu-240

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 11:11:24 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.825e-026	8.603e-025
Photon Energy Fluence Rate	MeV/cm²/sec	9.912e-028	4.674e-026
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.276e-030	1.073e-028
Absorbed Dose Rate in Air	mGy/hr	1.987e-032	9.369e-031
"	mrad/hr	1.987e-030	9.369e-029
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	3.395e-032	1.601e-030
o Opposed	"	1.750e-032	8.253e-031
o Rotational	"	1.654e-032	7.797e-031
o Isotropic	"	1.617e-032	7.623e-031
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	3.388e-032	1.598e-030
o Opposed	"	2.307e-032	1.088e-030
o Rotational	"	2.307e-032	1.088e-030
o Isotropic	"	1.715e-032	8.089e-031
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	2.566e-032	1.210e-030
o Posterior/Anterior	"	1.786e-032	8.420e-031
o Lateral	"	1.053e-032	4.966e-031
o Rotational	"	1.508e-032	7.112e-031
o Isotropic	"	1.226e-032	5.782e-031

Am 24/

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 10:52:18 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.751e-020	1.852e-018
Photon Energy Fluence Rate	MeV/cm²/sec	1.177e-021	1.259e-019
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.084e-024	2.204e-022
Absorbed Dose Rate in Air	mGy/hr	1.819e-026	1.924e-024
"	mrad/hr	1.819e-024	1.924e-022
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	3.223e-026	3.412e-024
o Opposed	"	1.690e-026	1.791e-024
o Rotational	"	1.618e-026	1.716e-024
o Isotropic	"	1.603e-026	1.701e-024
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	3.196e-026	3.382e-024
o Opposed	"	2.259e-026	2.396e-024
o Rotational	"	2.259e-026	2.396e-024
o Isotropic	"	1.664e-026	1.764e-024
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	2.617e-026	2.780e-024
o Posterior/Anterior	"	1.925e-026	2.049e-024
o Lateral	"	1.162e-026	1.239e-024
o Rotational	"	1.622e-026	1.727e-024
o Isotropic	"	1.324e-026	1.410e-024

Cm-243

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 10:55:04 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.210e-010	3.335e-008
Photon Energy Fluence Rate	MeV/cm²/sec	3.258e-011	8.907e-009
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	6.086e-014	1.661e-011
Absorbed Dose Rate in Air	mGy/hr	5.313e-016	1.450e-013
"	mrad/hr	5.313e-014	1.450e-011
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	7.061e-016	1.930e-013
o Opposed	"	4.852e-016	1.324e-013
o Rotational	"	4.853e-016	1.324e-013
o Isotropic	"	4.379e-016	1.195e-013
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	7.177e-016	1.960e-013
o Opposed	"	6.628e-016	1.809e-013
o Rotational	"	6.628e-016	1.809e-013
o Isotropic	"	4.691e-016	1.281e-013
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	6.090e-016	1.664e-013
o Posterior/Anterior	"	5.048e-016	1.379e-013
o Lateral	"	3.428e-016	9.360e-014
o Rotational	"	4.418e-016	1.207e-013
o Isotropic	"	3.665e-016	1.001e-013

Cm-244

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 10:56:00 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	2.011e-025	1.127e-023
Photon Energy Fluence Rate	MeV/cm²/sec	1.143e-026	6.409e-025
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.445e-029	1.370e-027
Absorbed Dose Rate in Air	mGy/hr	2.134e-031	1.196e-029
"	mrad/hr	2.134e-029	1.196e-027
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	3.703e-031	2.075e-029
o Opposed	"	1.916e-031	1.074e-029
o Rotational	"	1.816e-031	1.018e-029
o Isotropic	"	1.780e-031	9.979e-030
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	3.689e-031	2.067e-029
o Opposed	"	2.527e-031	1.416e-029
o Rotational	"	2.527e-031	1.416e-029
o Isotropic	"	1.874e-031	1.050e-029
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	2.857e-031	1.601e-029
o Posterior/Anterior	"	2.014e-031	1.129e-029
o Lateral	"	1.192e-031	6.680e-030
o Rotational	"	1.694e-031	9.496e-030
o Isotropic	"	1.381e-031	7.738e-030

Eu-152

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 10:58:51 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.572e-006	1.107e-004
Photon Energy Fluence Rate	MeV/cm²/sec	9.187e-006	1.467e-004
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.567e-008	2.528e-007
Absorbed Dose Rate in Air	mGy/hr	1.368e-010	2.207e-009
"	mrad/hr	1.368e-008	2.207e-007
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.550e-010	2.506e-009
o Opposed	"	1.347e-010	2.168e-009
o Rotational	"	1.347e-010	2.168e-009
o Isotropic	"	1.207e-010	1.940e-009
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.643e-010	2.659e-009
o Opposed	"	1.588e-010	2.567e-009
o Rotational	"	1.588e-010	2.567e-009
o Isotropic	"	1.272e-010	2.048e-009
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.397e-010	2.256e-009
o Posterior/Anterior	"	1.293e-010	2.084e-009
o Lateral	"	1.041e-010	1.669e-009
o Rotational	"	1.167e-010	1.879e-009
o Isotropic	"	1.039e-010	1.667e-009

Eu-154

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\SOILFL.MS5
Case Title: Soil Fill
This case was run on Thursday, March 15, 2001 at 10:59:56 AM
Dose Point # 1 - (780,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.002e-005	1.593e-004
Photon Energy Fluence Rate	MeV/cm²/sec	1.440e-005	2.195e-004
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.442e-008	3.749e-007
Absorbed Dose Rate in Air	mGy/hr	2.132e-010	3.273e-009
"	mrad/hr	2.132e-008	3.273e-007
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.414e-010	3.712e-009
o Opposed	"	2.103e-010	3.223e-009
o Rotational	"	2.103e-010	3.223e-009
o Isotropic	"	1.886e-010	2.887e-009
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.556e-010	3.934e-009
o Opposed	"	2.473e-010	3.802e-009
o Rotational	"	2.473e-010	3.802e-009
o Isotropic	"	1.985e-010	3.043e-009
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	2.176e-010	3.343e-009
o Posterior/Anterior	"	2.018e-010	3.094e-009
o Lateral	"	1.629e-010	2.488e-009
o Rotational	"	1.822e-010	2.792e-009
o Isotropic	"	1.624e-010	2.483e-009

Attachment 6-2
BNL Kd Report for Fill

Backfill Materials for the Maine Yankee Site

Bulk Density and Partition Coefficients for Co, Cs, Sr, and Ni

Mark Fuhrmann and Biays Bowerman
Environmental Sciences Department
Brookhaven National Laboratory

Partition Coefficients

Method

To determine the partition coefficients (K_D) of Co, Cs, Sr, and Ni, four materials from the Maine Yankee site were exposed to low activity tracers of ^{57}Co, ^{137}Cs, ^{85}Sr, and ^{63}Ni. The tracers each were prepared by initially diluting them from the "as received" concentrations of 100 Ci/mL to 4.76 Ci/mL. Two mL of each of the first three tracers (^{57}Co, ^{85}Sr, and ^{137}Cs) were mixed together and the pH was adjusted to 6.0, giving a final concentration of each tracer in the mixture of 0.476 Ci/mL. Stock solutions of ^{63}Ni were prepared separately because this pure beta-emitter had to be counted in a liquid scintillation counter.

^{57}Co, ^{85}Sr, and ^{137}Cs

For each sample of material to be tested, the contact solution was prepared by weighing out 44 g of distilled water into a plastic bottle and adding 1.0 mL of mixed tracer solution. The contact solution had a concentration of each tracer of 0.01 Ci/mL. The solution was mixed and 5 mL were removed and pipetted into a plastic counting vial. These 5 mL samples became the reference solutions against which the samples of liquid were compared after contact with the solids. Approximately 2 grams of each solid was weighed out and placed in the individual bottles of tracer. Four samples of each solid were prepared.

One of the bottles of each set was sampled at 24 hours, again at 72 hours, and a third time at 168 hours to check the uptake kinetics. Sampling was done by removing about 5 mL of solution by plastic syringe and then filtering the liquid through a syringe filter (0.45 m). This liquid was then pipetted into preweighed vials, which were reweighed to get the weight of the liquid.

Both the reference samples and the actual contact solutions were counted on an intrinsic germanium gamma detector with a Canberra spectroscopy system. The ^{57}Co, ^{85}Sr, and ^{137}Cs were measured at the 122, 514, and 661 keV gamma energies respectively. Because reference solutions were used for each of the triplicate samples, there was no need to calculate activities of the post-contact samples. Instead counts per minute per gram (CPM/g) were compared directly and used in calculation of K_D.

The first set of tracer solutions was sampled after contact with the solids for 24, 72, and 168 hours. The other three from each set were left in contact for 144 hours. Kinetics results are shown in Figures 1 to 3, indicating that uptake for both tracers was essentially complete. The partition coefficient is calculated as the concentration of an element of interest sorbed on the solid phase, divided by that elements final concentration the liquid with which the solid was in contact. Results for ^{57}Co are shown in Table 1. Results for ^{85}Sr are shown in Table 2. Results for ^{137}Cs are shown in Table 3. The pH of samples was measured after 336 hours; Clay A = 5.5, Crushed Rock A = 6.85, Sand = 5.32, and Gravel = 4.95.

Table 1.
Partition Coefficients for ^{57}Co

Sample	Individual K_D Values for ^{57}Co	Average K_D
Clay	11.4, 11.7, 12.9	12.0
Crushed Rock	5.6, 5.1, 5.1	5.3
Bank Run Sand	12.8, 13.9, 13.4	13.4
Bank Run Gravel	11.5, 13.1, 12.3	12.3

Table 2.
Partition Coefficients for ^{85}Sr

Sample	Individual K_D Values for ^{85}Sr	Average K_D
Clay	11.0, 12.1, 11.8	11.6
Crushed Rock	0.8, 1.2, 1.0	1.0
Bank Run Sand	6.6, 6.9, 6.9	6.8

Bank Run Gravel	4.0, 4.5, 4.5	4.3

Table 3.
Partition Coefficients for ^{137}Cs

Sample	Individual K_D Values for ^{137}Cs	Average K_D
Clay	25.0, 28.4, 33.4	28.9
Crushed Rock	34.7, 29.2, 35.0	33.0
Bank Run Sand	56.2, 53.5, 58.4	56.0
Bank Run Gravel	27.7, 32.2, 30.6	30.2

^{63}Ni

Solutions containing ^{63}Ni were prepared separately to allow for liquid scintillation counting. Preparations of the contact solutions were identical to those for the gamma emitting radionuclides. Sampling for measurements were different in that 1.0 mL of contact solution was withdrawn for counting, and mixed with 10 mL of Packard Ultima Gold liquid scintillation cocktail. An initial experimental solution was prepared and sampled after 24 hours. The remaining three solutions were sampled after 144 hours, since it was assumed that Ni would exhibit sorption kinetics similar to Co. Blank samples were also prepared to verify that leachable chemical constituents of the materials tested did not affect the quenching properties of the scintillator material. Samples were counted on a Wallac DSA for one minute each. Results for ^{63}Ni are shown in Table 4. Values for pH of the blank contact solutions were determined after 168 hours.

Table 4.
Partition Coefficients for ^{63}Ni

Sample	Individual K_D Values for ^{63}Ni	Average K_D
Clay	10.5, 14.1, 6.5	10.4
Crushed Rock	5.0, 5.4, 5.6	5.3

Bank Run Sand	11.2, 13.0, 13.6	12.6
Bank Run Gravel	6.0, 7.3, 10.0	7.8

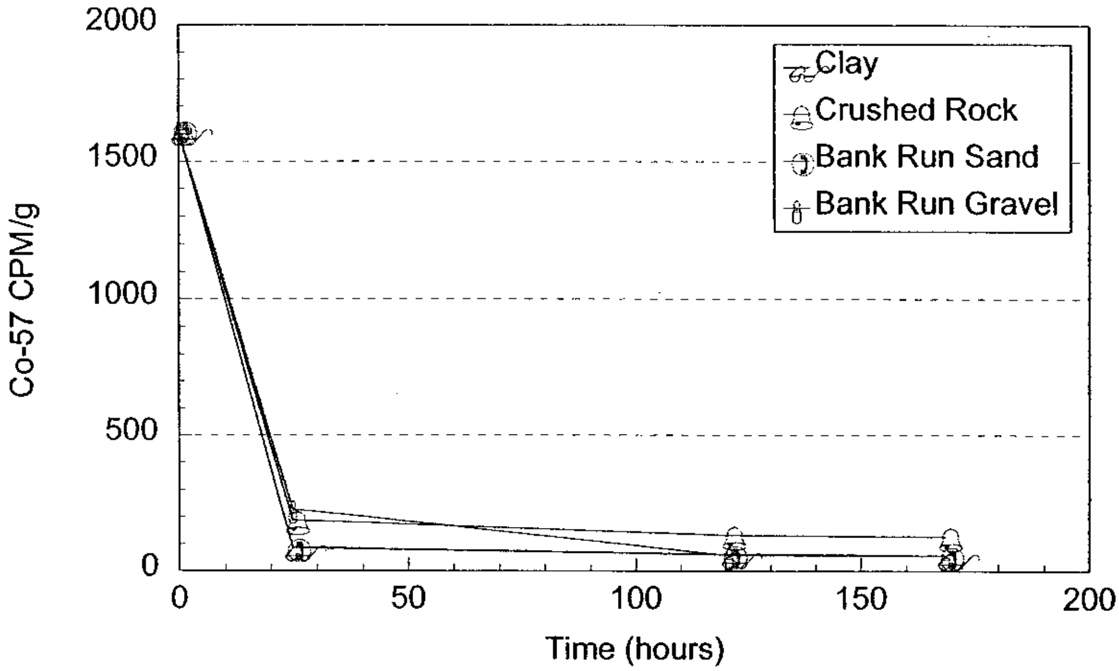


Figure 1. Uptake kinetics for Co-57 for the backfill materials.

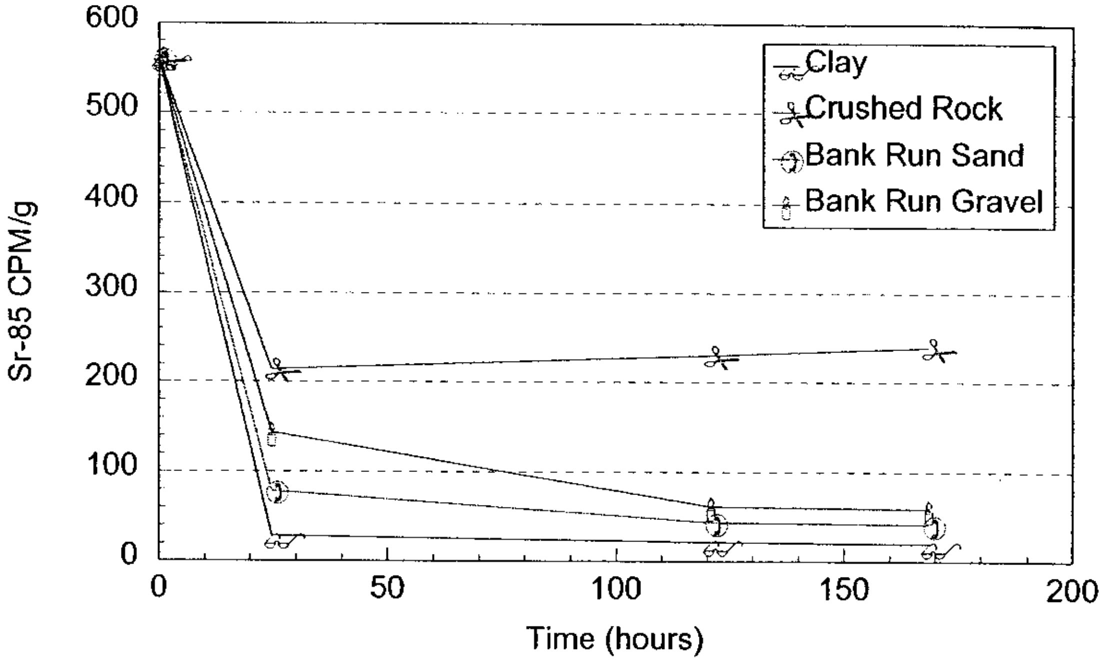


Figure 2. Uptake kinetics for Sr-85 for the backfill materials.

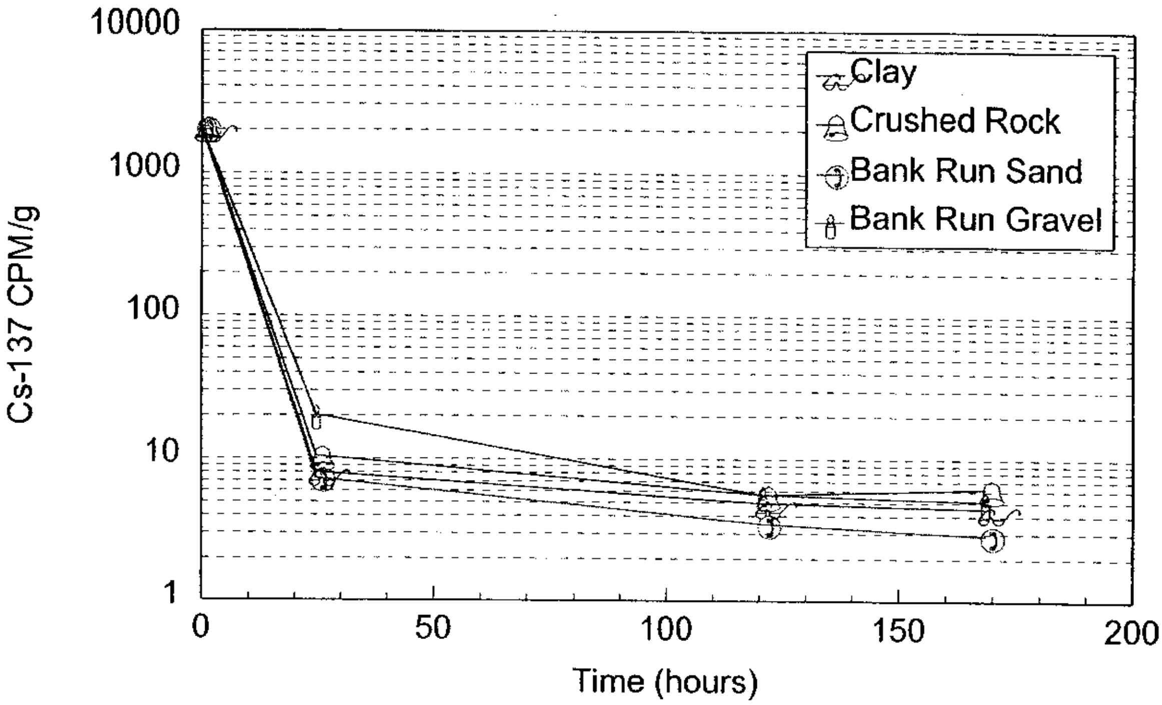


Figure 3. Uptake kinetics of Cs-137 for the backfill materials.

Please note that for the bank run gravel samples, we were not able to do the experiments with a large enough mass of solid that it would provide a representative value. Consequently the bank run gravel material was passed through a 4 mm (#5) sieve and that material was used for the K_D tests. To obtain the proper K_D for this material, the K_D should be multiplied by the fraction of material that passed the 4 mm sieve. We determined that 0.44 (44%) of the material was less than 4 mm; so each K_D value should be multiplied by 0.44 to obtain the correct value. Because our sample was relatively small for material containing so much gravel, it is advisable to check with the supplier to find out what fraction of the bulk material passes a No.5 sieve, and then correcting the K_D with that value.

Bulk Density

Method

Bulk density was determined in triplicate for the four materials. The bulk density of the clay was determined by placing a large (about 200 cc), preweighed, bolus of clay into a measured volume of water in a large graduated cylinder. The volume of the clay was determined by displacement. The other samples were not coherent and were poured into a graduated cylinder and were tamped down. The volume was measured from the graduations on the cylinder and then the sample was decanted and weighed.

Results

These data are plotted on Figure 4, with the slope being the bulk density. All results are linear (typical R^2 values were 0.98 or better) indicating good reproducibility. However, the bank run gravel samples did not produce a line that approached the origin. This indicates that we were not able to get a consistent mixture of sand and gravel for the samples. Bulk density values determined both as the slope from Figure 4 and by average are given in Table 5. It is recommended that the average values be used; the plots of the data and slope values are included to illustrate the small scatter in these determinations.

Table 5.
Bulk Density of Backfill Materials

Sample	**Bulk density from the slope (g/cc)**	**Bulk density from averages (g/cc)**
Clay	2.13	2.18
Bank Run Sand	1.31	1.47
Bank Run Gravel	1.20	1.70
Crushed Rock	1.63	1.63

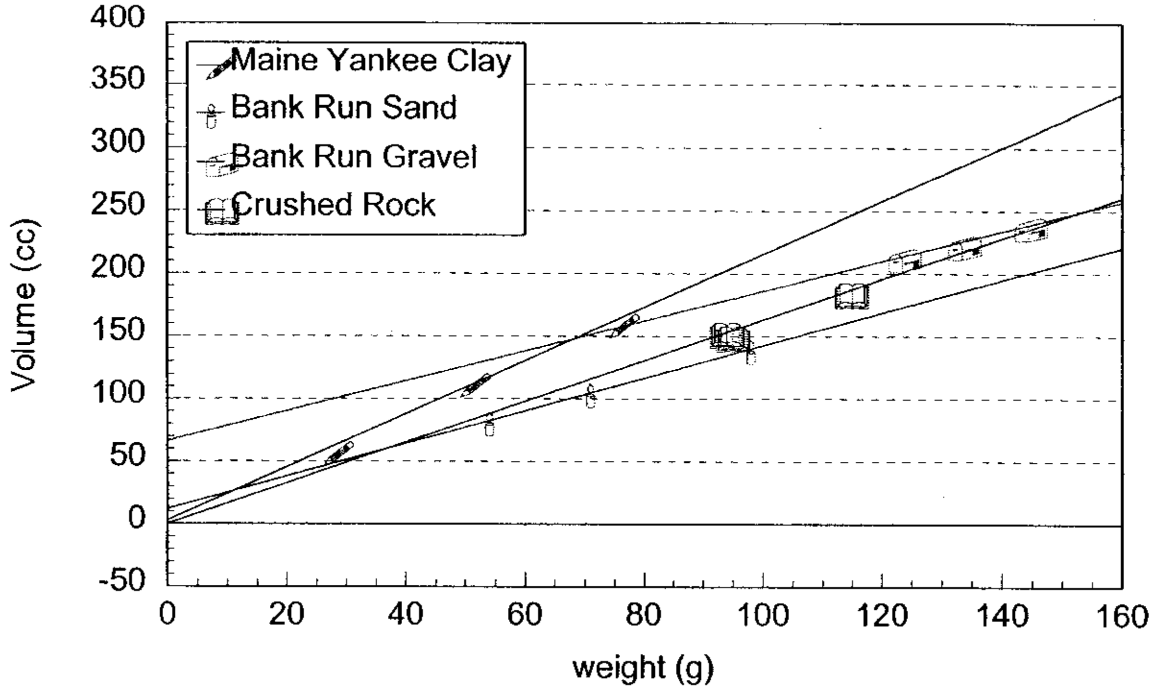


Figure 4. Data for bulk density of backfill material.

Attachment 6-3
BNL Kd Report for Concrete

TECHNICAL EVALUATION
OF
BNL K_d and Diffusion Coefficient Determination

TE-99-041

Purpose

This evaluation documents the determination of partition and diffusion coefficients for concrete samples from Maine Yankee which were used to support the dose evaluation section (section 6) of the License Termination Plan. The studies were conducted by Brookhaven National Laboratory.

References

1. "Leaching and Sorption of Radionuclides: Structural Concrete from Maine Yankee Nuclear Power Station", BNL, October 21, 1999.

Assumptions

None

Method

Six samples of contaminated concrete and three sets of clean concrete were crushed and submitted for testing. An Accelerated Leach Test was performed on five of the contaminated samples using ASTM C-1308 methods. The leachant volume was 10 times the surface area of the solid samples and was composed of 1 liter of distilled/deionized water. Forty milliliter aliquots were removed at specified intervals for gamma spectroscopy. Estimated detection limits for both Cs-137 and Co-60 were 40 pCi/l. Count rates were converted to pCi/l and input to the Accelerated Leach Test (ALT) computer model. The ALT code output is a table of Incremental Fraction Leached (IFL) and the Cumulative Fraction Leached (CFL). The effective diffusion coefficient and goodness-of-fit were determined for both the Diffusion and Partition models.

The partition coefficient (K_d) was determined for Cs-137 and Sr-90. Pieces of crushed concrete were immersed in distilled water containing the nuclide of interest. Uptake kinetics were determined by taking aliquots periodically, counting them and then returning them to the sample container. At the end of the test period, samples were filtered and counted. Sample count rates and reference count rates were determined. The K_d value was determined by dividing the count rate per gram of sample by the count rate per milliliter in the liquid. The pH of the leachate was also determined.

The DUST-MS code was used to determine the best fit effective diffusion coefficients from the experimental data.

The details of the analytical methods are contained in reference 1 attached.

Conclusions

Based on the goodness-of-fit results, diffusion is the transport mechanism for concrete. The effective diffusion coefficient for Cs-137 was 2E-10 cm^2/sec. K_d values for cesium and strontium averaged 3.0 mL/g and 1.0 mL/g respectively.

Plant specific values of diffusion and partition coefficients have been determined for use in performing dose assessment calculations to support section 6 of the LTP.

Prepared By: [signature] Date: 11/24/99

Reviewed By: Robert F Decker Date: 11/29/99

Leaching and Sorption of Radionuclides: Structural Concrete from Maine Yankee Nuclear Power Station

November 9, 1999

Mark Fuhrmann and Terrence Sullivan

516-344-2224

fuhrmann@bnl.gov

Environmental and Waste Technology Group

Brookhaven National Laboratory

Upton, NY 11973-5000

Summary

Six samples of contaminated structural concrete from the Maine Yankee Nuclear Power Station were received at Brookhaven National Laboratory (BNL) for leach testing. The leach test used is designed to determine if diffusion is the dominant rate controlling release mechanism from porous materials. If so the test method and computer code associated with it can be used to quantify the effective diffusion coefficient (D_e). This approach assumes a homogeneously distributed contaminant in the leached sample. However, there is evidence that the contaminants are actually in a thin layer (1 mm or less) on the surface of the concrete core samples. To estimate an effective diffusion coefficient that is more representative of this condition, the DUST code was applied to the experimental data. As described in Appendix B, after reevaluating the leach rate relative to the geometry of the contaminant, the best fit D_e for ^{137}Cs from the sample with the greatest leach rate (sample 4A) was 2 x 10^{-10} cm^2/sec.

Three sets of uncontaminated, crushed concrete were tested to determine partition coefficients (K_d) for ^{137}Cs and ^{85}Sr. With these tests the quantities of ^{137}Cs and ^{85}Sr that sorbed onto the fractured concrete were determined. Uptake of ^{137}Cs yielded a K_d of 3.0. For ^{90}Sr the K_d was 3.0. These values can be used as input to the DUST code to determine how much sorption reduces releases from the facility.

METHODS

The Accelerated Leach Test (ASTM C-1308) was started for five samples on September 14, 1999. With the observation that these samples all had coatings of paint or epoxy on them, one of the samples was removed from testing and two additional samples (with the epoxy removed) were sent to BNL. These samples were added to the test set, starting on September 20, 1999. The leach test was run according to the test protocol. The leachant volume was 10 times the surface area of the solid sample, with the volume of distilled/deionized water used for each sample, in each interval, being about 1.0 liter. All weighing was done on calibrated and recently certified balances. Sample parameters are given in Table 1.

Aliquots of 40 mL were taken at each interval for gamma spectroscopy. All samples were counted in the same geometry containers. Two intrinsic germanium gamma detectors were used. Each was calibrated with a NIST traceable mixed gamma standard (#678-59) from Isotope Products Laboratories. This standard contained both ^{137}Cs and ^{60}Co, which allowed direct comparisons to the leaching samples. The standard was diluted and counted in the same geometry as the samples, on each detector. At the end of the counting campaign, samples of distilled/deionized water were counted as blanks, again in the same geometry, for 2000 minutes each. One detector was observed to have a low background for ^{137}Cs, which was subtracted from the data obtained with that detector.

Count rates were converted to pCi/L on an Excel spread sheet, and then input to the Accelerated Leach Test (ALT) computer model. Estimated detection limits for both ^{137}Cs and ^{60}Co are 40 pCi/L. The parameters used in the calculations are shown in Table 1 for each sample. Spread sheets for each sample are included in Appendix A. Output of the code is a sheet that tabulates the Incremental Fraction Leached (IFL) and the Cumulative Fraction Leached (CFL). The effective diffusion coefficient and "goodness-of-fit" parameter are also given for both the Diffusion and Partition models. Figures showing the CFL as a function of time are also included in Appendix A.

The partition coefficient (K_d) was experimentally determined for ^{137}Cs and ^{90}Sr. Pieces of broken concrete from Maine Yankee were contacted with distilled water (adjusted to pH = 7.0) that contained the radionuclide of interest. As shown in Fig.1, 3-6 pieces were used, each being about 2 cm. Uptake kinetics were determined by taking periodic samples of the water, counting it and then returning it to the experiment. Experiments were started by weighing out distilled water, adding tracer, and then taking an aliquot as a reference. At the end of the experiment about 5 mL were withdrawn with a plastic syringe, and the water was pushed through a 0.45 micron syringe filter. Aliquots were pipetted into preweighed vials; the vials were then reweighed and counted. Uptake on the concrete was determined by taking the difference in count rates between the sample and the reference. The K_d is the count rate per gram on the solid divided by the count rate per mL in the liquid, at steady-state. After sampling, pH measurements were taken from the leachate. The instrument was standardized with newly made pH reference solutions at 7.0 and 4.01.

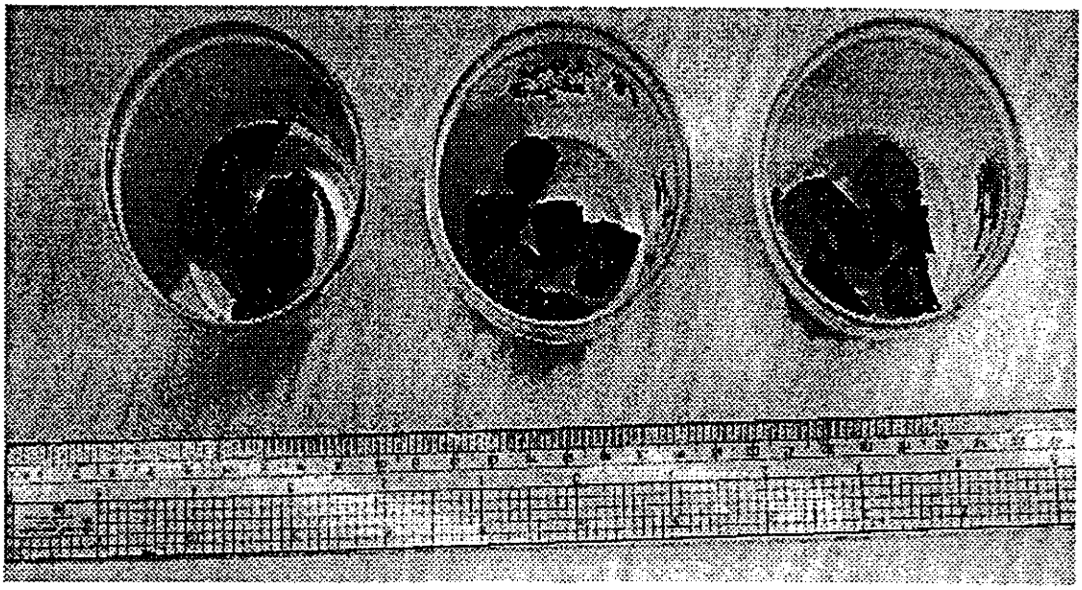


Figure 1. Samples of concrete used in the ^{137}Cs experiment for K_d determination.

Table 1.

Concrete Samples for Leach Testing

Sample	Weight (g)	Diameter (cm)	Height (cm)	Leachant Volume (L)	Source Term Cs-137 (pCi)	Source Term Co-60 (pCi)
1A	117.4	6.97	1.41	1.070	372,100	200
2A	105.4	6.89	1.36	1.040	553,300	359,700
4A	125.2	6.91	1.46	1.070	249,200	200
8A*	103.8	6.92	1.16	1.000	25,000	31,900
32A	93.8	6.95	1.17	1.010	336,000	19,100
41A	101.0	6.92	1.42	1.060	113,000	21,100

* Sample 8A contains 30,100 pCi of Eu-152.

RESULTS

Results of the leach tests are summarized in Table 2. Effective diffusion coefficients for ^{137}Cs range from 9 x 10^{-9} to 5 x 10^{-11} cm^2/sec. One of the bare concrete samples leached the fastest while the other was very slow. Alternatively, there may still be some epoxy in the pores of the bare concrete with the low leach rate. Effective diffusion coefficients for ^{60}Co were about the same or somewhat lower than ^{137}Cs. In some of the samples, inventories were so low that no ^{60}Co could be detected in the leachate. No releases of ^{152}Eu were observed from sample 8A.

Releases of ^{137}Cs fit the diffusion model very well. Generally if the goodness-of-fit parameter is less than 2%, the fit of the model to the data indicates diffusion as the transport mechanism. All of the samples have goodness-of-fit values for ^{137}Cs lower than 2%; with most being significantly lower than 1%. The samples (2A and 41A) with high values had thick layers of epoxy on their contaminated surfaces. For these samples several processes or rates may be controlling ^{137}Cs releases. It is likely that diffusion at several rates (from the epoxy and the concrete) presents an averaged rate to produce the observed leaching curve. For ^{60}Co, sample 2A had a goodness-of-fit value of 0.35% while 8A had 2.38%. Leaching data, ALT output, and figures showing the cumulative fraction released as a function of time, are given in Appendix A.

The results presented above assume that the source term is distributed, homogeneously, through the entire sample. However, there is evidence that the activity on the concrete is actually in a 1 mm thick layer at the concrete surface. Because the diffusion coefficient is very sensitive to the path length through the sample, the ALT model was run using a 1mm thickness for sample 4A as well as the measured 14 mm. At 14 mm, D_e for ^{137}Cs was 8 x 10^{-9} cm^2/sec. When the thickness was altered to 1 mm, D_e for ^{137}Cs was 7 x 10^{-11} cm^2/sec, with no change in the "goodness-of-fit" parameter. The diffusion coefficient responds to the reduction in thickness by becoming lower by almost two orders of magnitude, in order to keep the fraction released the same (as was observed experimentally). This estimated D_e is based on releases from both sides of a uniformly contaminated cylinder. There is evidence that the contamination actually resides in a 1mm thick layer which is backed by clean concrete. To examine this case in detail the DUST-MS computer code was used. Results of this analysis are discussed in Appendix B. From this modeling a best fit effective diffusion coefficient for Cs (for sample 4A) was estimated to be 2×10^{-10} cm^2/sec. This is based on a 1 mm thick contaminated layer with clean concrete on one side and water on the other.

Effective diffusion coefficients for ^{60}Co were determined for only two of the six samples; those with the greatest inventories of the radionuclide. Concentrations were below detection limits in the leachate from the other samples. Observed values of D_e were 1×10^{-10} and 3×10^{-11}, which were calculated based on a homogeneous distribution of the contaminant in the sample. It is believed that ^{60}Co is actually present in a layer of about 0.2 mm thickness. This being the case, the value of D_e would decrease by an order of magnitude or more.

No ^{152}Eu was observed in the leachate although it was specifically searched for. This is not surprising because rare earths typically partition strongly to the solid phase. Moreover, sample 8A, the only one containing observable activities of this radionuclide, represents material that was activated. One would therefore expect ^{152}Eu to be retained in minerals in the aggregate (or the cement itself) that contained the traces of Eu that were activated.

Partition coefficients were determined for ^{137}Cs and ^{85} Sr in contact with structural concrete obtained from the site. Kinetics of uptake were examined for ^{137}Cs to determine the correct contact time for the experiment. Figure 2 shows that ^{137}Cs uptake follows a square root of time function and is mostly complete by 160 hours. The ^{137}Cs K_d sampling was done at that time. Results for ^{137}Cs and ^{85}Sr are given in tables 3 and 4 respectively. Values of K_d for ^{137}Cs average 3.0 mL/g; while for ^{85}Sr the average is 1.0 mL/g.

Table 2.

Summary of Radionuclide Leaching from Structural Concrete

Maine Yankee Nuclear Power Station

Sample	Description	D_e Cs-137 cm^2/S	Cs-137 goodness of fit	Fraction Leached Cs-137	D_e Co-60 cm^2/S	Fraction Leached Co-60	pH of final sample
1A	Bare concrete, epoxy removed	5.6×10^{-11}	0.22	0.019	---	---	7.9
2A	Concrete with two layers of epoxy, ~ 1mm thick	4.9×10^{-11}	1.74	0.015	1.03×10^{-10}	0.027	6.9
4A	Bare concrete, epoxy removed	8.0×10^{-9}	0.35	0.195	---	---	6.5
8A	Concrete with a thin layer of white paint	3.3×10^{-9}	0.07	0.146	3.3×10^{-11}	0.019	7.6
32A	Concrete with a thin layer of white paint	4.6×10^{-10}	0.51	0.058	---	---	7.5
41A	Concrete with three layers ~ 2mm thick	8.0×10^{-11}	1.21	0.020	---	—	6.3

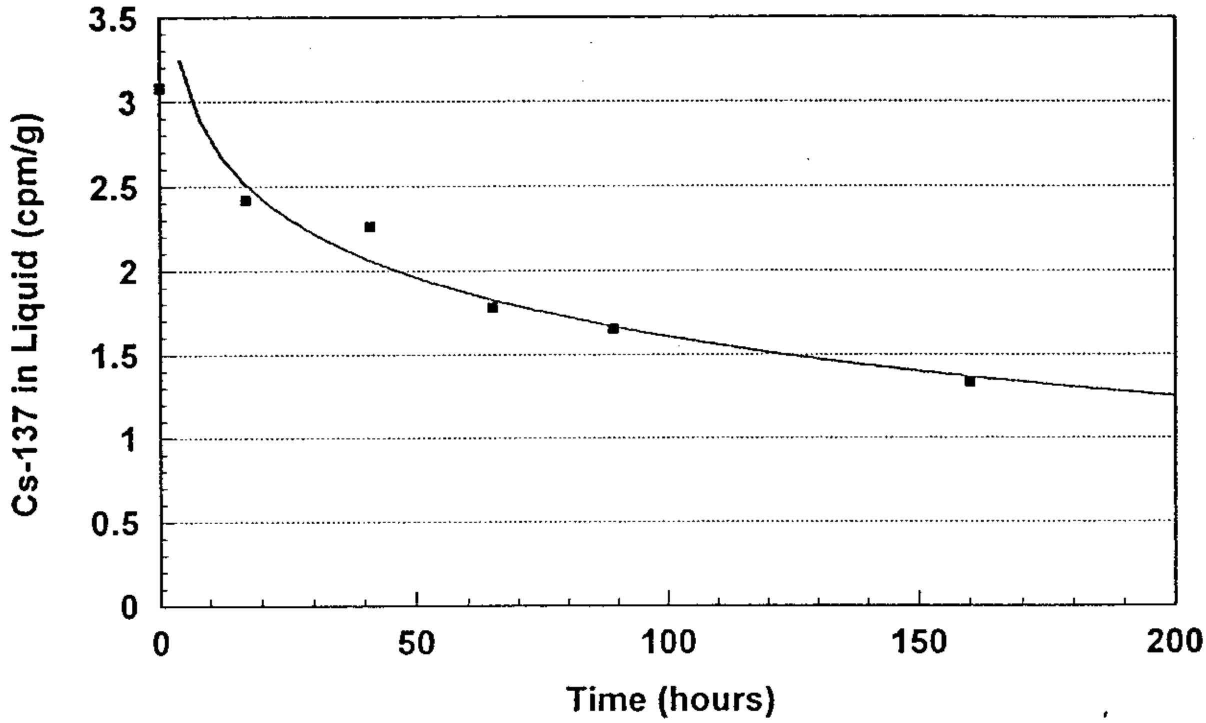


Figure 2. Kinetics of Cs-137 uptake on structural concrete from Maine Yankee.

Table 3.

K_d Values for Cs-137 in Contact with Yankee Concrete Samples

Contact Time: 160 hours

Sample	Start CPM/g	End CPM/g	Δ CPM/g	Liquid Volume (g)	Concrete Wt (g)	Counts on Solid CPM/g	K_d Cs-137	pH
1B	3.08	1.33	1.75	48.4	16.900	5.01	2.9	11.2
2B	2.93	1.82	1.11	48.6	18.294	2.95	2.7	11.5
3B	2.93	1.46	1.47	48.4	14.575	4.88	3.3	11.32

Table 4

K_d Values for Sr-85 in Contact with Yankee Concrete Samples

Contact Time: 143 hours

Sample	Start CPM/g	End CPM/g	Δ CPM/g	Liquid Volume (mL)	Concrete Wt (g)	Counts on Solid CPM/g	K_d Sr-85	pH
1	16.96	13.13	3.83	50.0	15.35	9.54	0.73	11.1
2	18.05	14.60	3.45	50.0	12.32	14.00	0.96	11.3
3	13.78	10.85	2.93	50.0	10.70	13.69	1.26	11.2

Attachment 6-4
Irrigation Memorandum

MEMO

Date: 10-20-99

To: George Pillsbury

From: Robert F. Decker

Subject: TE99-020 documentation of telephone calls from USDA/NRCS representatives

On September 1, 1999 an e-mail was sent to Norman Kalloch, USDA-NRCS representative in the Orono, ME (207 990-9100) regarding local (Lincoln County) well irrigation rates. Unfortunately, his office was in the process of changing over to a new server system and the message was not received until some time later. On September 10, 1999 Mr. Kalloch contacted me by telephone. During the conversation Mr. Kalloch confirmed that agriculture in Maine does not rely to any significant extent on well or surface water irrigation. The majority of irrigation occurs in the northern portion of the State and is primarily associated with potato crops. To provide local agricultural irrigation information Mr Kalloch directed me to contact Ms. Mary Thompson in Warren Maine. Ms. Thompson is the local Lincoln county extension representative (207 273- 2005).

On September 10, 1999 following the conversation with Mr. Kalloch I contacted Mary Thompson. Ms. Thompson stated that precipitation (rain) is the principal source of irrigation for family gardens. She said that local irrigation rates from wells would not be expected to exceed 4-5 inches per year for family gardens and 7-8 inches per year for commercial growers. She stated that these rates are relative to drought years, normal years would result in less well irrigation. She also stated that pumping cost for family and commercial growers is a contributing factor for the stated irrigation rates as are low well production rates especially during drought years where there is a greater concern for conserving the water for domestic usage. Ms. Thompson also stated that in the coastal region salt water intrusion of the well is also a consideration by local residents. This latter concern is a significant consideration during drought years. Ms. Thompson forwarded the latest copy of the USDA report for local irrigation and farm usage. Ms. Thompson concluded that the principal local commercial crops irrigated are strawberries.

On September 16, 1999 I was contacted by Paul Hughes (207 990-9100 #3) the USDA agronomist for Maine. Mr. Hughes confirmed the conditions and rates provided by Mr Kalloch and Ms. Thompson and reiterated the reasons and conditions provided by Ms. Thompson regarding local well usage. Mr. Hughes concluded that recommendations to commercial strawberries growers was to provide the crops one inch of water per week. The recommendations to commercial growers is to supplement their crops to a 1 inch per week rate with irrigation water if the weekly rainfall is less than one inch per week.

Attachment 6-5
Concrete Density

TECHNICAL EVALUATION
OF
Concrete Porosity and Density

TE-99-039

Purpose

This TE documents the porosity and density of Maine Yankee concrete samples as determined by Earth Engineering Services, Inc. of Baltimore, Maryland.

References

1. Letter dated June 9, 1999 from Earth Engineering.

2. ASTM C 642-97, "Standard Test Method for Density, Absorption, and Voids in Hardened Concrete.

Assumptions

None

Method

Clean concrete samples from Maine Yankee were submitted to Earth Engineering Services, Inc. for analysis in order to determine the porosity and density. ASTM test method C 642-97 was followed for performing the analyses.

The results of the analyses were as follows;

	Core# A9900/01FL2	Core# A9900/01MC3
Bulk Density	2.21 g/cc	2.27 g/cc
Porosity	14.6%	13.7%

Conclusion

The density and porosity of concrete at the Maine Yankee site have been determined using standard test methods.

Prepared By: [signature] Date: 11/22/99

Reviewed By: Robert F Decker Date: 12/3/99. Calculations (attached) checked for correctness & verified RFD

Earth Engineering

3401 CARLINS PARK DRIVE BALTIMORE, MARYLAND 21215 (410) 466-1400 FAX: (410) 466-7371

June 9, 1999

Maine Yankee Atomic Power Plant
Stone & Webster Decommissioning Team
Old Ferry and Bailey Point Road
Wiscasset, ME 04578

Attention: Mr. Robert J. Tozzie
Stone & Webster/ Radiological Services, Inc.

Re: Concrete Core Samples
Bulk Density & Porosity Tests
E2Si Project No. 99-160

Dear Mr. Tozzie:

Test results for the 2 core samples are summarized below.

	CORE #A9900/01FL2	CORE #A9900/01MC3
Bulk Density (Dry)	2.21	2.27
Bulk Density After Immersion	2.34	2.38
Bulk Density After Immersion & Boiling	2.36	2.40
Apparent Density	2.59	2.63
Permeable Pore Space (voids)	14.6%	13.7%

* Density in units of grams per cubic centimeter

If we can be of further assistance, please contact us.

Very truly yours,

EARTH ENGINEERING & SCIENCES, INC.

Paul A. D'Amato

Paul A. D'Amato, P.E.
Vice President

PAD/ew/proj.doc/S&W

E2Si Earth Engineering & Sciences, Inc.	SUBJECT Maine Yankee Concrete Cores - Bulk Density and Porosity	SHEET NO. 1 OF 1 JOB NO. 99-160 BY PAD DATE 6/8/99 CHK'D DATE REV. DATE

Reference: ASTM C 642

Core # A9900/01FL2 (5.8" Dia)

Oven Dry Weight = 2956.8 gm
Saturated Wt. After Immersion = 3125.0 gm
Saturated Wt. After Boiling = 3151.6 gm
Immersed Wt. = 1816.0 gm.

Bulk Density (dry) = 2956.8/(3151.6 - 1816.0) = 2.21

Bulk Density (After Immersion) = 3125.0/(3151.6 - 1816.0) = 2.34

Bulk Density (After Immersion & Boiling) = 3151.6/(3151.6 - 1816.0) = 2.36

Apparent Density = 2956.8/(2956.8 - 1816.0) = 2.59

Permeable Pore Space (Voids) = (3151.6 - 2956.8)/(3151.6 - 1816.0)
= 0.146 = 14.6%

Core # A9900/01ME3 (2.7" Dia)

Oven Dry Weight = 1082.1 gm
Saturated Wt. After Immersion = 1139.3 gm
Saturated Wt. After Boiling = 1147.7 gm
Immersed Weight = 670.0 gm

Bulk Density (Dry) = 1082.1/(1147.7 - 670.0) = 2.27
Bulk Density After Immersion = 1139.3/(1147.7 - 670.0) = 2.38
Bulk Density After Immersion & Boiling = 1147.1/(1147.1 - 670.0) = 2.40

Apparent Density = 1082.1/(1082.1 - 670.0) = 2.63

Permeable Pore Space (Voids) = (1147.7 - 1082.1)/(1147.7 - 670.0)
= 0.137 = 13.7%

Designation: C 642 – 97

Standard Test Method for Density, Absorption, and Voids in Hardened Concrete[1]

This standard is issued under the fixed designation C 642; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This test method covers the determinations of denisty, percent absorption, and percent voids in hardened concrete.

1.2 The text of this test method references notes and footnotes which provide explanatory information. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of this standard.

2. Significance and Use

2.1 This test method is useful in developing the data required for conversions between mass and volume for concrete. It can be used to determine conformance with specifications for concrete and to show differences from place to place within a mass of concrete.

3. Apparatus

3.1 *Balance*, sensitive to 0.025 % of the mass of the specimen.

3.2 *Container*, suitable for immersing the specimen and suitable wire for suspending the specimen in water.

4. Test Specimen

4.1 Whenever possible, the sample shall consist of several individual portions of concrete, each to be tested separately. The individual portions may be pieces of cylinders, cores, or beams of any desired shape or size, except that the volume of each portion shall be not less than 350 cm^3 (or for normal weight concrete, approximately 800 g); and each portion shall be free from observable cracks, fissures, or shattered edges.

5. Procedure

5.1 *Oven-Dry Mass*—Determine the mass of the portions, and dry in an oven at a temperature of 100 to 110°C for not less than 24 h. After removing each specimen from the oven, allow it to cool in dry air (preferably in a desiccator) to a temperature of 20 to 25°C and determine the mass. If the specimen was comparatively dry when its mass was first determined, and the second mass closely agrees with the first, consider it dry. If the specimen was wet when its mass was first determined, place it in the oven for a second drying treatment of 24 h and again determine the mass. If the third value checks the second, consider the specimen dry. In case of any doubt, redry the specimen for 24-h periods until check values of mass are obtained. If the difference between values obtained from two successive values of mass exceeds 0.5 % of the lesser value, return the specimens to the oven for an additional 24-h drying period, and repeat the procedure until the difference between any two successive values is less than 0.5 % of the lowest value obtained. Designate this last value *A*.

5.2 *Saturated Mass After Immersion*—Immerse the specimen, after final drying, cooling, and determination of mass, in water at approximately 21°C for not less than 48 h and until two successive values of mass of the surface-dried sample at intervals of 24 h show an increase in mass of less than 0.5 % of the larger value. Surface-dry the specimen by removing surface moisture with a towel, and determine the mass. Designate the final surface-dry mass after immersion *B*.

5.3 *Saturated Mass After Boiling*—Place the specimen, processed as described in 5.2, in a suitable receptacle, covered with tap water, and boil for 5 h. Allow it to cool by natural loss of heat for not less than 14 h to a final temperature of 20 to 25°C. Remove the surface moisture with a towel and determine the mass of the specimen. Designate the soaked, boiled, surface-dried mass *C*.

5.4 *Immersed Apparent Mass*—Suspend the specimen, after immersion and boiling, by a wire and determine the apparent mass in water. Designate this apparent mass *D*.

6. Calculation

6.1 By using the values for mass determined in accordance with the procedures described in Section 5, make the following calculations:

$$\text{Absorption after immersion, } \% = [(B - A)/A] \times 100 \quad (1)$$

$$\text{Absorption after immersion and boiling, } \% = [(C - A)/A] \times 100 \quad (2)$$

$$\text{Bulk density, dry} = [A/(C - D)] \cdot \rho = g_1 \quad (3)$$

$$\text{Bulk density after immersion} = [B/(C - D)] \cdot \rho \quad (4)$$

$$\text{Bulk density after immersion and boiling} = [C/(C - D)] \cdot \rho \quad (5)$$

$$\text{Apparent density} = [A/(A - D)] \cdot \rho = g_2 \quad (6)$$

$$\text{Volume of permeable pore space (voids), } \% = (g_2 - g_1)/g_2 \times 100$$
$$\text{or } (C - A)/(C - D) \times 100 \quad (7)$$

where:

A = mass of oven-dried sample in air, g
B = mass of surface-dry sample in air after immersion, g
C = mass of surface-dry sample in air after immersion and boiling, g
D = apparent mass of sample in water after immersion and boiling, g
g_1 = bulk density, dry, Mg/m^3 and
g_2 = apparent density, Mg/m^3
ρ = density of water = 1 Mg/m^3 = 1 g/cm^3.

[1] This test method is under the jurisdiction of ASTM Committee C-9 on Concrete and Concrete Aggregates and is the direct responsibility of Subcommittee C09.69 on Miscellaneous Tests.

Current edition approved Jan. 10, 1997. Published March 1997. Originally published as C 642 – 69 T. Last previous edition C 642 – 90.

7. Exampl
7.1 Ass
7.1.1 M
7.1.2 T
"permeabl
7.1.3 Al
Mg/m^3.
7.1.4 V
(no water)
7.2 The
100 cm^3
content is
7.3 Ass
sorbed.
7.4 Ass
water is al
7.5 Bas
the data t
in Section
7.5.1 C
7.5.2 M
7.5.3 M
7.5.4 A
boiling, I

NOTE 1
water, and
after imme

7.6 By
tions des
obtained

Absorptio

Absorptio

Bulk den

Bulk den

7. Example

7.1 Assume a sample having the following characteristics:

7.1.1 Mass of the solid part of the specimen = 1000 g.

7.1.2 Total volume of specimen (including solids, "permeable" voids, and "impermeable" voids) = 600 cm^3.

7.1.3 Absolute density of solid part of specimen = 2.0 Mg/m^3.

7.1.4 Void space in specimen contains initially only air (no water).

7.2 Then, it follows that there are 500 cm^3 of solids and 100 cm^3 of voids making up the specimen, and the void content is 1/6 = 16.67 %.

7.3 Assume that on immersion 90 mL of water is absorbed.

7.4 Assume that after immersion and boiling 95 mL of water is absorbed.

7.5 Based on the assumptions given in 7.1 to 7.4 above, the data that would be developed from the procedures given in Section 5 would be as follows:

7.5.1 Oven-dry mass, A = 1000 g.

7.5.2 Mass in air after immersion, B = 1090 g.

7.5.3 Mass in air after immersion and boiling, C = 1095 g.

7.5.4 Apparent mass in water after immersion and boiling, D = 495 g.

NOTE 1—Since loss of mass in water is equal to mass of displaced water, and volume of specimen = 600 cm^3, mass of specimen in water after immersion and boiling is 1095 − 600 = 495 g.

7.6 By using the data given above to perform the calculations described in Section 6, the following results will be obtained (Note 2):

Absorption after immersion, % $= [(B - A)/A] \times 100 = [(1090 - 1000)/1000] \times 100 = 9.0$

Absorption after immersion and boiling, % $= [(C - A)/A] \times 100 = [(1095 - 1000)/1000] \times 100 = 9.5$

Bulk density, dry $= [A/(C - D)] \cdot \rho = [1000/(1095 - 495)] \times 1 = 1.67\ Mg/m^3 = g_1$

Bulk density after immersion $= [B/(C - D)] \cdot \rho = [1090/(1095 - 495)] \times 1 = 1.82$

Bulk density after immersion and boiling $= [C/(C - D)]\ \rho = [1095/(1095 - 495)] \times 1 = 1.83\ Mg/m^3$

Apparent density $= [A/(A - D)]\ \rho = [1000/(1000 - 495)] \times 1 = 1.98\ Mg/m^3 = g_2$

Volume of permeable voids, %
$= [(g_2 - g_1)/g_2] \times 100 = [(1.98 - 1.67)/1.98] \times 100 = 15.8$, or $[(C - A)/(C - D)] \times 100 = [(1095 - 1000)/(1095 - 495)] \times 100 = 15.7$

NOTE 2—This test method does not involve a determination of absolute density. Hence, such pore space as may be present in the specimen that is not emptied during the specified drying or is not filled with water during the specified immersion and boiling or both is considered "impermeable" and is not differentiated from the solid portion of the specimen for the calculations, especially those for percent voids. In the example discussed it was assumed that the absolute density of the solid portion of the specimen was 2.0 Mg/m^3, the total void space was 16.67 %, and the impermeable void space was 5 cm^3. The operations, if performed, and the calculations, if performed as described, have the effect of assuming that there are 95 cm^3 of pore space and 505 cm^3 of solids, and indicate that the solid material, therefore, has an apparent density of 1.98 rather than the absolute density of 2.00 Mg/m^3 and the specimen has a percentage of voids of 15.8 rather than 16.67.

Depending on the pore size distribution and the pore entry radii of the concrete and on the purposes for which the test results are desired, the procedures of this test method may be adequate, or they may be insufficiently rigorous. In the event that it is desired to fill more of the pores than will be filled by immersion and boiling, various techniques involving the use of vacuum treatment or increased pressures may be used. If a rigorous measure of total pore space is desired, this can only be obtained by determining absolute density by first reducing the sample to discrete particles, each of which is sufficiently small so that no impermeable pore space can exist within any of the particles. If the absolute density were determined and designated g_3, then:

Total void volume, % $= (g_3 - g_1)/g_3 \times 100 = (2.00 - 1.67)/2.00 \times 100 = 16.5$

8. Precision and Bias

8.1 *Precision*—At present there are insufficient data available to justify attempting to develop a precision statement for this test method.

8.2 *Bias*—Bias for this test method cannot be determined since there is no reference standard available for comparison.

9. Keywords

9.1 absorption; concrete-hardened; density; voids

Attachment 6-6
Activated Concrete Inventory

Activated Concrete Inventory

Activated Concrete Activity

ICI Sump Geometry:
The sump is a cylinder 35 feet tall with a floor diameter of 17 feet (at elevation -39 feet) and 4 to 10 foot thick walls. The wall ID increases to 24 feet at elevation -34 feet. The wall area was calculated as 35 ft by 78 ft. The length was approximated by the mid-wall (2 foot thick) cylinder diameter of 25 feet.

The samples taken from the wall of the reactor shield were all less than 1 pCi/g. The amount of concrete to reduce the activity by 4 orders of magnitude for the floor was 22 inches. For this calculation, 24 inches of wall material are assumed to be contaminated to 1 pCi/g.

Wall Area = 2.54E6 cm2	Floor Area = 2.11E5 cm2
Wall Volume = 1.55E8 cm3	Floor Volume = 1.07E6 cm3 (2 inch remaining)
Wall Mass = 3.41E8 g	Floor Mass = 2.35E6 g

Total Activity at 1 pCi/g (following remediation)

Total Concrete Vol = 1.07E6 cm3 + 1.55E8cm3 = 1.56E8 cm3

1 pCi/g x 2.2 g/cm3 x 1.56E8 cm3 = 3.43E8 pCi

Attachment 6-7
Embedded Piping

Embedded Pipe Description

Component	Pipe diameter	Pipe length	Pipe Area, m2	Pipe Volume, m3
Containment Foundation Drains-drain pipe	6 inch	122 ft	18	0.68
Containment Foundation Drains-drain lines to sump	3 inch	256 ft	19	1.4
Containment Spray Pipe	16 inch	72 ft	28	2.8
MSV House Pipe- 4"	4 inch	22 ft	2.1	0.05
-8"	8 inch	22 ft	4.3	0.22
-8"	8 inch	22 ft	4.3	0.22
-1.5"	1.5 inch	22 ft	0.8	0.01
Personnel Hatch Pipe-6"CH	6 inch	8 ft	1.2	0.04
-3"spare	3 inch	8 ft	0.6	0.01
-6"CH	6 inch	12 ft	1.8	0.07
-3"PL	3 inch	12 ft	0.9	0.04
-1.5 spare	1.5 inch	12 ft	0.4	0.004
Containment Pipe Penetrations				
- CS-40,CS-41	32 inch	8 ft	4	0.32
-penetration	30 inch	8 ft	6	1.1
-penetration	24 inch	24 ft	14	2.1
-penetration	10 inch	24 ft	6	0.37
-penetration	2 inch	16 ft	1	0.0099
-penetration	42 inch	12 ft	12	3.3
-penetration	30 inch	12 ft	9	1.7
-penetration	16 inch	20 ft	8	0.79
-penetration	40 inch	8 ft	8	2
-penetration	42 inch	8 ft	8	2.2
-penetration	12 inch	24 ft	7	0.53
-penetration	8 inch	36 ft	7	0.36
Total		790 ft	172 m2	20.3 m3

Attachment 6-8
Deep Soil Microshield Output

Microshield
Deep Soil Direct Dose
Unitized Values

This attachment provides the Microshield outputs for direct dose factors for deep soil. The area size is 10,000 m2 by 4.85 m deep. Soil density is 1.6 g/cm3. The dose point is 1 meter above the soil surface.

The direct dose factors are determined by multiplying the fraction of the time spent indoors (0.6571) by the external gamma shielding factor (0.5512) then adding the fraction of time spent outdoors (0.1101). The resulting number is multiplied by 24 hours per day for 365 days per year.

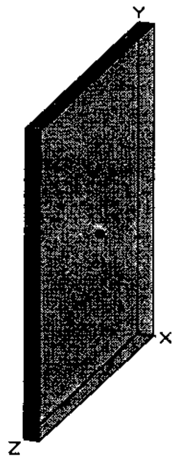
Nuclide	Direct Dose Factor (mrem/y per pCi/g)
H-3	0.00E+00
Ni-63	0.00E+00
Co-60	2.40E+00
Cs-137	4.00E-01

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : DEEPSL.MS5
Run Date: March 16, 2001
Run Time: 4:26:00 PM
Duration : 00:00:08

File Ref:
Date:
By:
Checked:

Case Title: Deep Soil
Description: Direct Dose Rate for Unit Activity
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	485.0 cm	15 ft 10.9 in
Width	1.0e+4 cm	328 ft 1.0 in
Height	1.0e+4 cm	328 ft 1.0 in

Dose Points

	X	Y	Z
# 1	600 cm	5000 cm	5000 cm
	19 ft 8.2 in	164 ft 0.5 in	164 ft 0.5 in

Shields

Shield Name	Dimension	Material	Density
Source	4.85e+10 cm³	SiO2	1.6
Shield 1	15.0 cm	SiO2	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Co-60	7.7600e-002	2.8712e+009	1.6000e-006	5.9200e-002

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Page : 2
DOS File : DEEPSL.MS5
Run Date: March 16, 2001
Run Time: 4:26:00 PM
Duration : 00:00:08

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	4.684e+05	1.700e-06	1.179e-05	3.282e-09	2.276e-08
1.1732	2.871e+09	3.889e-02	1.728e-01	6.950e-05	3.088e-04
1.3325	2.871e+09	5.301e-02	2.144e-01	9.198e-05	3.720e-04
TOTALS:	5.743e+09	9.191e-02	3.873e-01	1.615e-04	6.809e-04

Co-60

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\DEEPSL.MS5
Case Title: Deep Soil
This case was run on Friday, March 16, 2001 at 4:26:00 PM
Dose Point # 1 - (600,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	7.294e-002	3.082e-001
Photon Energy Fluence Rate	MeV/cm²/sec	9.191e-002	3.873e-001
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.615e-004	6.809e-004
Absorbed Dose Rate in Air	mGy/hr	1.410e-006	5.944e-006
"	mrad/hr	1.410e-004	5.944e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.601e-006	6.750e-006
o Opposed	"	1.378e-006	5.809e-006
o Rotational	"	1.378e-006	5.809e-006
o Isotropic	"	1.231e-006	5.188e-006
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.704e-006	7.187e-006
o Opposed	"	1.641e-006	6.918e-006
o Rotational	"	1.641e-006	6.918e-006
o Isotropic	"	1.304e-006	5.498e-006
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.441e-006	6.078e-006
o Posterior/Anterior	"	1.327e-006	5.596e-006
o Lateral	"	1.055e-006	4.447e-006
o Rotational	"	1.195e-006	5.038e-006
o Isotropic	"	1.057e-006	4.457e-006

Cs-137

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\DEEPSL.MS5
Case Title: Deep Soil
This case was run on Friday, March 16, 2001 at 4:27:15 PM
Dose Point # 1 - (600,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.255e-002	9.091e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.302e-003	6.015e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.610e-005	1.166e-004
Absorbed Dose Rate in Air	mGy/hr	1.405e-007	1.018e-006
"	mrad/hr	1.405e-005	1.018e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.664e-007	1.205e-006
o Opposed	"	1.332e-007	9.650e-007
o Rotational	"	1.332e-007	9.650e-007
o Isotropic	"	1.178e-007	8.534e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.768e-007	1.281e-006
o Opposed	"	1.679e-007	1.217e-006
o Rotational	"	1.679e-007	1.217e-006
o Isotropic	"	1.259e-007	9.123e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.471e-007	1.066e-006
o Posterior/Anterior	"	1.298e-007	9.407e-007
o Lateral	"	9.628e-008	6.976e-007
o Rotational	"	1.160e-007	8.407e-007
o Isotropic	"	9.878e-008	7.157e-007

Attachment 6-9
Deep Soil RESRAD Output

Deepsoil, waterpathways, sitekds
Gerber adjustments

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
File: Default.LIB

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ni-63	6.290E-06	6.290E-06	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ni-63	5.770E-07	5.770E-07	DCF3(1)
D-34	Food transfer factors:			
D-34	Ni-63 , plant/soil concentration ratio, dimensionless	5.000E-02	5.000E-02	RTF(1,1)
D-34	Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(1,2)
D-34	Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-02	2.000E-02	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ni-63 , fish	1.000E+02	1.000E+02	BIOFAC(1,1)
D-5	Ni-63 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(1,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R011	Area of contaminated zone (m**2)	1.000E+04	1.000E+04	---
R011	Thickness of contaminated zone (m)	4.850E+00	2.000E+00	---
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---
R011	Basic radiation dose limit (mrem/yr)	1.500E+01	3.000E+01	---
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---
R011	Times for calculations (yr)	3.000E+01	1.000E+00	---
R011	Times for calculations (yr)	3.500E+01	3.000E+00	---
R011	Times for calculations (yr)	4.000E+01	1.000E+01	---
R011	Times for calculations (yr)	not used	3.000E+01	---
R011	Times for calculations (yr)	not used	1.000E+02	---
R011	Times for calculations (yr)	not used	3.000E+02	---
R011	Times for calculations (yr)	not used	1.000E+03	---
R011	Times for calculations (yr)	not used	0.000E+00	---
R011	Times for calculations (yr)	not used	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): Ni-63	1.000E+00	0.000E+00	---
R012	Concentration in groundwater (pCi/L): Ni-63	not used	0.000E+00	---
R013	Cover depth (m)	1.500E-01	0.000E+00	---
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---
R013	Contaminated zone total porosity	3.000E-01	4.000E-01	---
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---
R013	Contaminated zone hydraulic conductivity (m/yr)	3.200E+01	1.000E+01	---
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---
R013	Humidity in air (g/m**3)	not used	8.000E+00	---
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---
R013	Irrigation mode	overhead	overhead	---
R013	Runoff coefficient	2.000E-01	2.000E-01	---
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---
R014	Saturated zone effective porosity	1.000E-02	2.000E-01	---
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---
R014	Saturated zone hydraulic conductivity (m/yr)	3.200E+01	1.000E+02	---
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---
R014	Saturated zone b parameter	5.030E+00	5.300E+00	---
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---
R015	Number of unsaturated zone strata	1	1	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R015	Unsat. zone 1, thickness (m)	2.000E+00	4.000E+00	---
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+03	1.000E+01	---
R016	Distribution coefficients for Ni-63			
R016	Contaminated zone (cm**3/g)	8.000E+00	1.000E+03	---
R016	Unsaturated zone 1 (cm**3/g)	8.000E+00	1.000E+03	---
R016	Saturated zone (cm**3/g)	8.000E+00	1.000E+03	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	7.926E-03
R016	Solubility constant	0.000E+00	0.000E+00	not used
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---
R017	Exposure duration	3.000E+01	3.000E+01	---
R017	Shielding factor, inhalation	not used	4.000E-01	---
R017	Shielding factor, external gamma	not used	7.000E-01	---
R017	Fraction of time spent indoors	not used	5.000E-01	---
R017	Fraction of time spent outdoors (on site)	not used	2.500E-01	---
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular ARE
R017	Radii of shape factor array (used if FS = -1):			
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---
R017	Fractions of annular areas within AREA:			
R017	Ring 1	not used	1.000E+00	---
R017	Ring 2	not used	2.732E-01	---
R017	Ring 3	not used	0.000E+00	---
R017	Ring 4	not used	0.000E+00	---
R017	Ring 5	not used	0.000E+00	---
R017	Ring 6	not used	0.000E+00	---
R017	Ring 7	not used	0.000E+00	---
R017	Ring 8	not used	0.000E+00	---
R017	Ring 9	not used	0.000E+00	---
R017	Ring 10	not used	0.000E+00	---
R017	Ring 11	not used	0.000E+00	---
R017	Ring 12	not used	0.000E+00	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---
R018	Milk consumption (L/yr)	not used	9.200E+01	---
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---
R018	Fish consumption (kg/yr)	not used	5.400E+00	---
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---
R018	Soil ingestion rate (g/yr)	not used	3.650E+01	---
R018	Drinking water intake (L/yr)	4.785E+02	5.100E+02	---
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---
R018	Contamination fraction of household water	not used	1.000E+00	---
R018	Contamination fraction of livestock water	not used	1.000E+00	---
R018	Contamination fraction of irrigation water	not used	1.000E+00	---
R018	Contamination fraction of aquatic food	not used	5.000E-01	---
R018	Contamination fraction of plant food	not used	-1	---
R018	Contamination fraction of meat	not used	-1	---
R018	Contamination fraction of milk	not used	-1	---
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---
R019	Depth of soil mixing layer (m)	not used	1.500E-01	---
R019	Depth of roots (m)	not used	9.000E-01	---
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---
R019	Household water fraction from ground water	not used	1.000E+00	---
R019	Livestock water fraction from ground water	not used	1.000E+00	---
R019	Irrigation fraction from ground water	not used	1.000E+00	---
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---
R19B	Translocation Factor for Leafy	not used	1.000E+00	---
R19B	Translocation Factor for Fodder	not used	1.000E+00	---
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---
STOR	Storage times of contaminated foodstuffs (days):			
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---
STOR	Leafy vegetables	1.000E+00	1.000E+00	---
STOR	Milk	1.000E+00	1.000E+00	---
STOR	Meat and poultry	2.000E+01	2.000E+01	---
STOR	Fish	7.000E+00	7.000E+00	---
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---
STOR	Well water	1.000E+00	1.000E+00	---
STOR	Surface water	1.000E+00	1.000E+00	---
STOR	Livestock fodder	0.000E+00	4.500E+01	---
R021	Thickness of building foundation (m)	not used	1.500E-01	---
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---
R021	Total porosity of the cover material	not used	4.000E-01	---
R021	Total porosity of the building foundation	not used	1.000E-01	---
R021	Volumetric water content of the cover material	not used	5.000E-02	---
R021	Volumetric water content of the foundation	not used	3.000E-02	---
R021	Diffusion coefficient for radon gas (m/sec):			
R021	in cover material	not used	2.000E-06	---
R021	in foundation material	not used	3.000E-07	---
R021	in contaminated zone soil	not used	2.000E-06	---
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---
R021	Height of the building (room) (m)	not used	2.500E+00	---
R021	Building interior area factor	not used	0.000E+00	---
R021	Building depth below ground surface (m)	not used	-1.000E+00	---
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---
TITL	Number of graphical time points	32	---	---
TITL	Maximum number of integration points for dose	1	---	---
TITL	Maximum number of integration points for risk	17	---	---

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	suppressed
2 -- inhalation (w/o radon)	suppressed
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	suppressed
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions

Area:	10000.00 square meters
Thickness:	4.85 meters
Cover Depth:	0.15 meters

Initial Soil Concentrations, pCi/g

Ni-63	1.000E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	3.000E+01	3.500E+01	4.000E+01
TDOSE(t):	0.000E+00	1.599E-02	2.523E-02	2.339E-02
M(t):	0.000E+00	1.066E-03	1.682E-03	1.560E-03

Maximum TDOSE(t): 2.613E-02 mrem/yr at t = 32.70 ñ 0.07 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.270E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.270E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Ni-63	2.613E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	2.613E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R015	Unsat. zone 1, thickness (m)	2.000E+00	4.000E+00	---
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+03	1.000E+01	---
R016	Distribution coefficients for Co-60			
R016	Contaminated zone (cm**3/g)	9.400E+00	1.000E+03	---
R016	Unsaturated zone 1 (cm**3/g)	9.400E+00	1.000E+03	---
R016	Saturated zone (cm**3/g)	9.400E+00	1.000E+03	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.762E-03
R016	Solubility constant	0.000E+00	0.000E+00	not used
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---
R017	Exposure duration	3.000E+01	3.000E+01	---
R017	Shielding factor, inhalation	not used	4.000E-01	---
R017	Shielding factor, external gamma	not used	7.000E-01	---
R017	Fraction of time spent indoors	not used	5.000E-01	---
R017	Fraction of time spent outdoors (on site)	not used	2.500E-01	---
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular ARE
R017	Radii of shape factor array (used if FS = -1):			
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---
R017	Fractions of annular areas within AREA:			
R017	Ring 1	not used	1.000E+00	---
R017	Ring 2	not used	2.732E-01	---
R017	Ring 3	not used	0.000E+00	---
R017	Ring 4	not used	0.000E+00	---
R017	Ring 5	not used	0.000E+00	---
R017	Ring 6	not used	0.000E+00	---
R017	Ring 7	not used	0.000E+00	---
R017	Ring 8	not used	0.000E+00	---
R017	Ring 9	not used	0.000E+00	---
R017	Ring 10	not used	0.000E+00	---
R017	Ring 11	not used	0.000E+00	---
R017	Ring 12	not used	0.000E+00	---

Contaminated Zone Dimensions

Area:	10000.00 square meters
Thickness:	4.85 meters
Cover Depth:	0.15 meters

Initial Soil Concentrations, pCi/g

Co-60	1.000E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	3.000E+01	3.500E+01	3.799E+01	4.000E+01
TDOSE(t):	0.000E+00	0.000E+00	7.661E-03	8.569E-03	6.759E-03
M(t):	0.000E+00	0.000E+00	5.108E-04	5.713E-04	4.506E-04

Maximum TDOSE(t): 8.569E-03 mrem/yr at t = 37.99 ñ 0.08 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.799E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.799E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-60	8.569E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	8.569E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R015	Unsat. zone 1, thickness (m)	2.000E+00	4.000E+00	---
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+03	1.000E+01	---
R016	Distribution coefficients for H-3			
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	4.998E-01
R016	Solubility constant	0.000E+00	0.000E+00	not used
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---
R017	Exposure duration	3.000E+01	3.000E+01	---
R017	Shielding factor, inhalation	not used	4.000E-01	---
R017	Shielding factor, external gamma	not used	7.000E-01	---
R017	Fraction of time spent indoors	not used	5.000E-01	---
R017	Fraction of time spent outdoors (on site)	not used	2.500E-01	---
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular ARE
R017	Radii of shape factor array (used if FS = -1):			
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---
R017	Fractions of annular areas within AREA:			
R017	Ring 1	not used	1.000E+00	---
R017	Ring 2	not used	2.732E-01	---
R017	Ring 3	not used	0.000E+00	---
R017	Ring 4	not used	0.000E+00	---
R017	Ring 5	not used	0.000E+00	---
R017	Ring 6	not used	0.000E+00	---
R017	Ring 7	not used	0.000E+00	---
R017	Ring 8	not used	0.000E+00	---
R017	Ring 9	not used	0.000E+00	---
R017	Ring 10	not used	0.000E+00	---
R017	Ring 11	not used	0.000E+00	---
R017	Ring 12	not used	0.000E+00	---

Contaminated Zone Dimensions	
Area:	10000.00 square meters
Thickness:	4.85 meters
Cover Depth:	0.15 meters

Initial Soil Concentrations, pCi/g	
H-3	1.000E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	5.000E-01	6.760E-01	1.000E+00
TDOSE(t):	0.000E+00	4.564E-02	2.166E-01	1.804E-01
M(t):	0.000E+00	3.043E-03	1.444E-02	1.202E-02

Maximum TDOSE(t): 2.167E-01 mrem/yr at t = 0.677 ñ 0.001 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 6.766E-01 years

Water Independent Pathways (Inhalation excludes radon)

Radio- Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 6.766E-01 years

Water Dependent Pathways

Radio- Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
H-3	2.167E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	2.167E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R015	Unsat. zone 1, thickness (m)	2.000E+00	4.000E+00	---
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+03	1.000E+01	---
R016	Distribution coefficients for Cs-137			
R016	Contaminated zone (cm**3/g)	3.460E+01	1.000E+03	---
R016	Unsaturated zone 1 (cm**3/g)	3.460E+01	1.000E+03	---
R016	Saturated zone (cm**3/g)	3.460E+01	1.000E+03	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.855E-03
R016	Solubility constant	0.000E+00	0.000E+00	not used
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---
R017	Exposure duration	3.000E+01	3.000E+01	---
R017	Shielding factor, inhalation	not used	4.000E-01	---
R017	Shielding factor, external gamma	not used	7.000E-01	---
R017	Fraction of time spent indoors	not used	5.000E-01	---
R017	Fraction of time spent outdoors (on site)	not used	2.500E-01	---
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular ARE
R017	Radii of shape factor array (used if FS = -1):			
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---
R017	Fractions of annular areas within AREA:			
R017	Ring 1	not used	1.000E+00	---
R017	Ring 2	not used	2.732E-01	---
R017	Ring 3	not used	0.000E+00	---
R017	Ring 4	not used	0.000E+00	---
R017	Ring 5	not used	0.000E+00	---
R017	Ring 6	not used	0.000E+00	---
R017	Ring 7	not used	0.000E+00	---
R017	Ring 8	not used	0.000E+00	---
R017	Ring 9	not used	0.000E+00	---
R017	Ring 10	not used	0.000E+00	---
R017	Ring 11	not used	0.000E+00	---
R017	Ring 12	not used	0.000E+00	---

```
     Contaminated Zone Dimensions          Initial Soil Concentrations, pCi/g
     ----------------------------          ----------------------------------
      Area:  10000.00 square meters              Cs-137     1.000E+00
 Thickness:      4.85 meters
Cover Depth:     0.15 meters
```

```
                         Total Dose TDOSE(t), mrem/yr
                   Basic Radiation Dose Limit =  15 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)
--------------------------------------------------------------------------
   t (years):  0.000E+00  5.000E+01  1.000E+02  1.390E+02  1.500E+02
    TDOSE(t):  0.000E+00  0.000E+00  0.000E+00  2.663E-02  2.058E-02
        M(t):  0.000E+00  0.000E+00  0.000E+00  1.775E-03  1.372E-03

Maximum TDOSE(t):  2.675E-02 mrem/yr   at t =   139.4 ñ 0.3 years
```

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.394E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.394E+02 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
Cs-137	2.675E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	2.675E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Attachment 2

RESRAD Concentration Report

Table of Contents

Part IV: Concentration of Radionuclides

Concentration of radionuclides in environmental media
at t = 0.000E+00 years

Radio-Nuclide	Contaminated Zone	Surface Soil*	Air Particulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
Ni-63	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters,
i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 0.000E+00 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
Ni-63	0.000E+00	4.167E+01	4.167E+01	4.167E+01	4.167E+01	5.646E+00	5.271E+01	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters,
i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 3.000E+01 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Ni-63	6.348E-01	1.270E-01	6.749E-08	5.797E+01	5.797E-01

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.000E+01 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Ni-63	5.793E+01	4.835E+01	1.160E+02	1.513E+02	1.528E+02	3.509E+01	2.641E+02	5.769E+01	5.769E+01

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 3.270E+01 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Ni-63	6.094E-01	1.328E-01	7.062E-08	9.463E+01	9.463E-01

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.270E+01 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Ni-63	9.465E+01	6.077E+01	1.712E+02	2.304E+02	2.314E+02	5.507E+01	4.076E+02	9.465E+01	9.465E+01

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 3.500E+01 years

Radio-Nuclide	Contaminated Zone	Surface Soil*	Air Particulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
Ni-63	5.885E-01	1.373E-01	7.300E-08	9.139E+01	9.139E-01

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.500E+01 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
Ni-63	9.140E+01	5.887E+01	1.654E+02	2.237E+02	2.235E+02	5.350E+01	3.938E+02	9.141E+01	9.141E+01

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 4.000E+01 years

Radio-Nuclide	Contaminated Zone	Surface Soil*	Air Particulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
Ni-63	5.456E-01	1.455E-01	7.734E-08	8.473E+01	8.473E-01

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

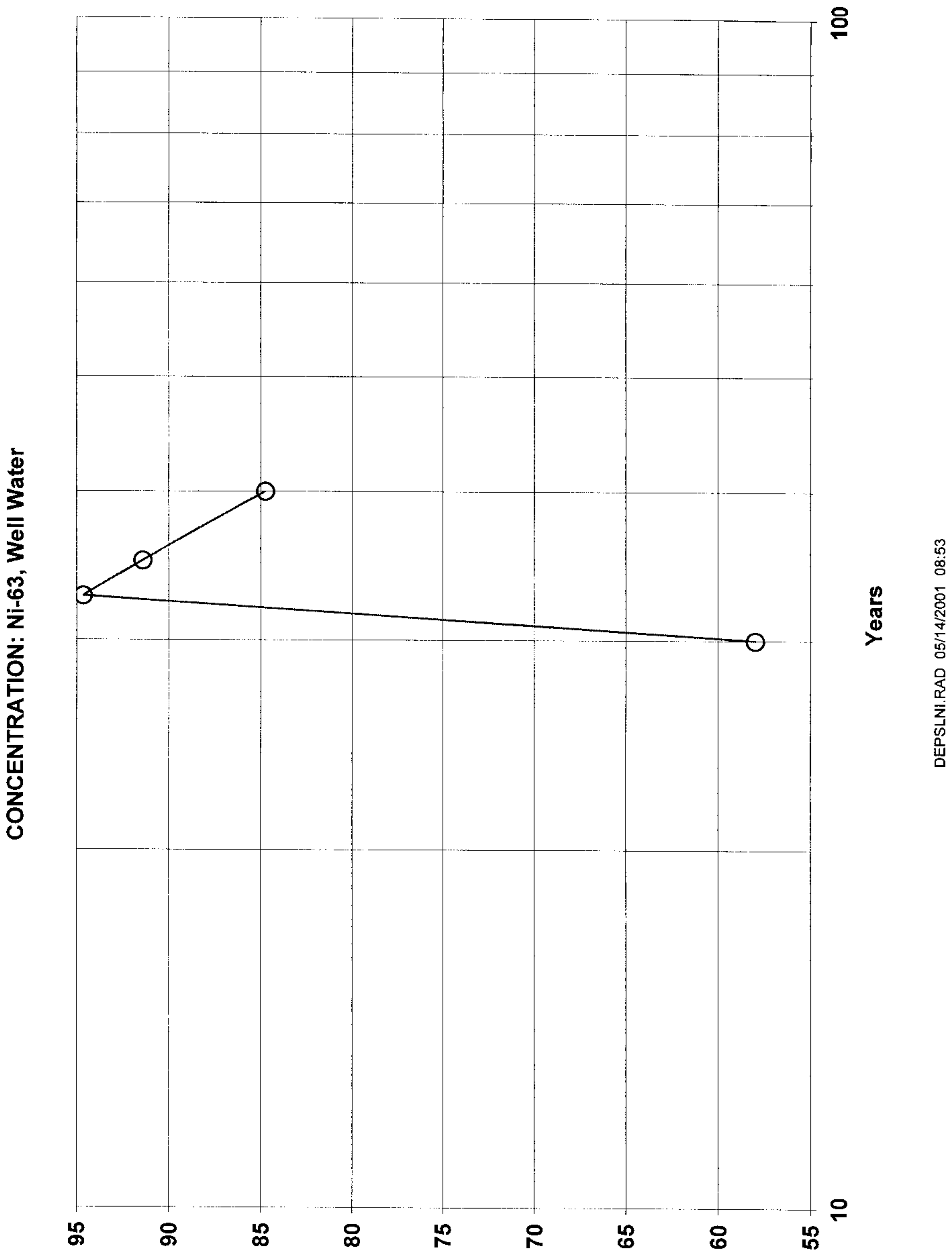
Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 4.000E+01 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
Ni-63	8.473E+01	5.472E+01	1.535E+02	2.075E+02	2.074E+02	4.966E+01	3.654E+02	8.474E+01	8.474E+01

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.


CONCENTRATION: Ni-63, Well Water
pCi/l
95
90
85
80
75
70
65
60
55
10
100
Years
DEPSLNI.RAD 05/14/2001 08:53

Concentration of radionuclides in environmental media
at t = 3.799E+01 years

Radio-Nuclide	Contaminat-ted Zone	Surface Soil*	Air Par-ticulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
Co-60	5.234E-03	1.326E-03	7.046E-10	6.660E-01	6.660E-03

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

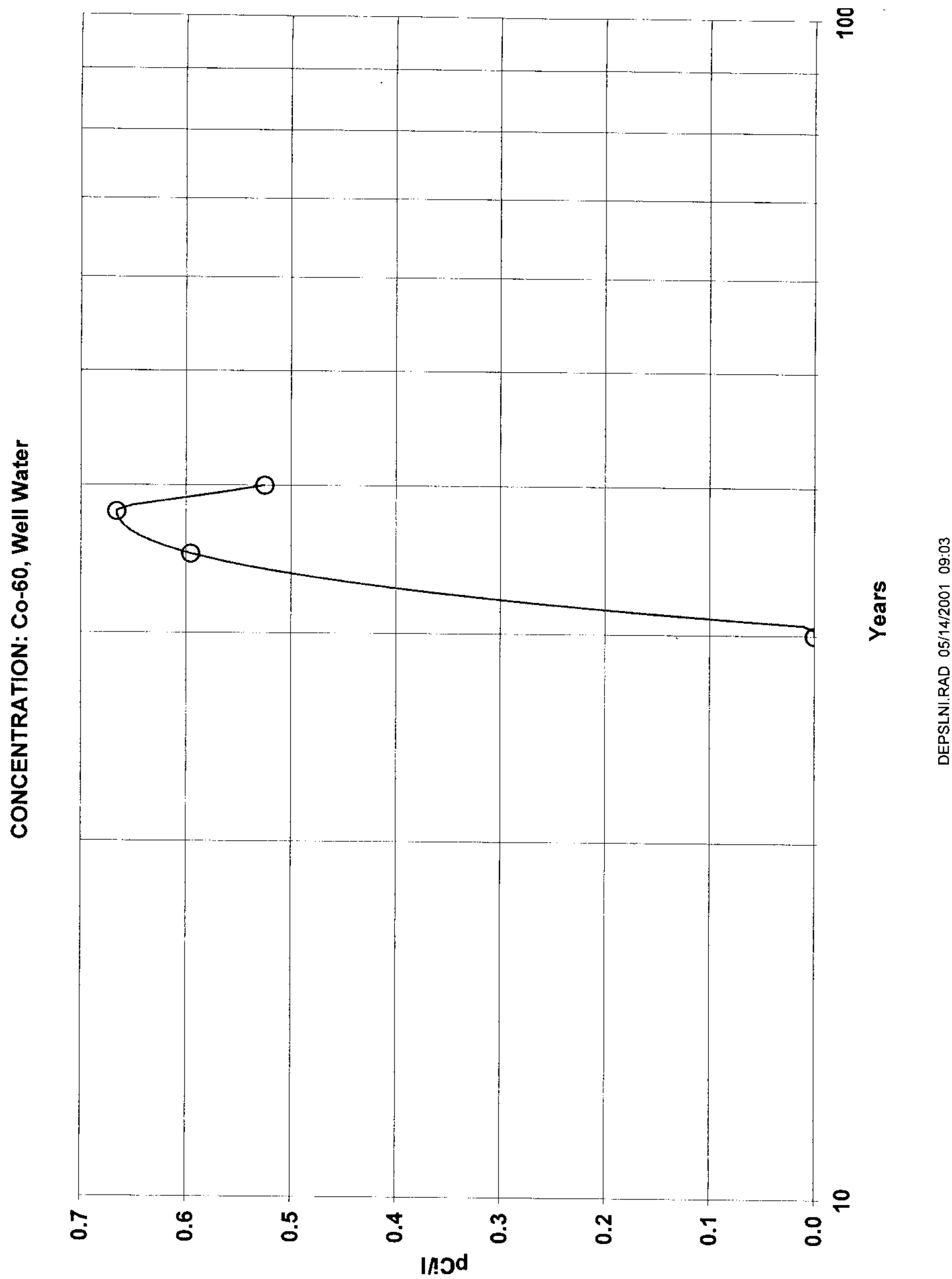
Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.799E+01 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
Co-60	6.657E-01	6.105E-01	1.385E+00	1.812E+00	1.810E+00	1.649E+00	3.100E-01	1.993E+00	1.329E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.


CONCENTRATION: Co-60, Well Water
pCi/l
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
10
100
Years
DEPSLNI.RAD 05/14/2001 09:03

Concentration of radionuclides in environmental media
at t = 6.760E-01 years

Radio-Nuclide	Contaminated Zone	Surface Soil*	Air Particulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
H-3	5.794E-01	2.611E-03	1.388E-09	7.042E+03	7.042E+01

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

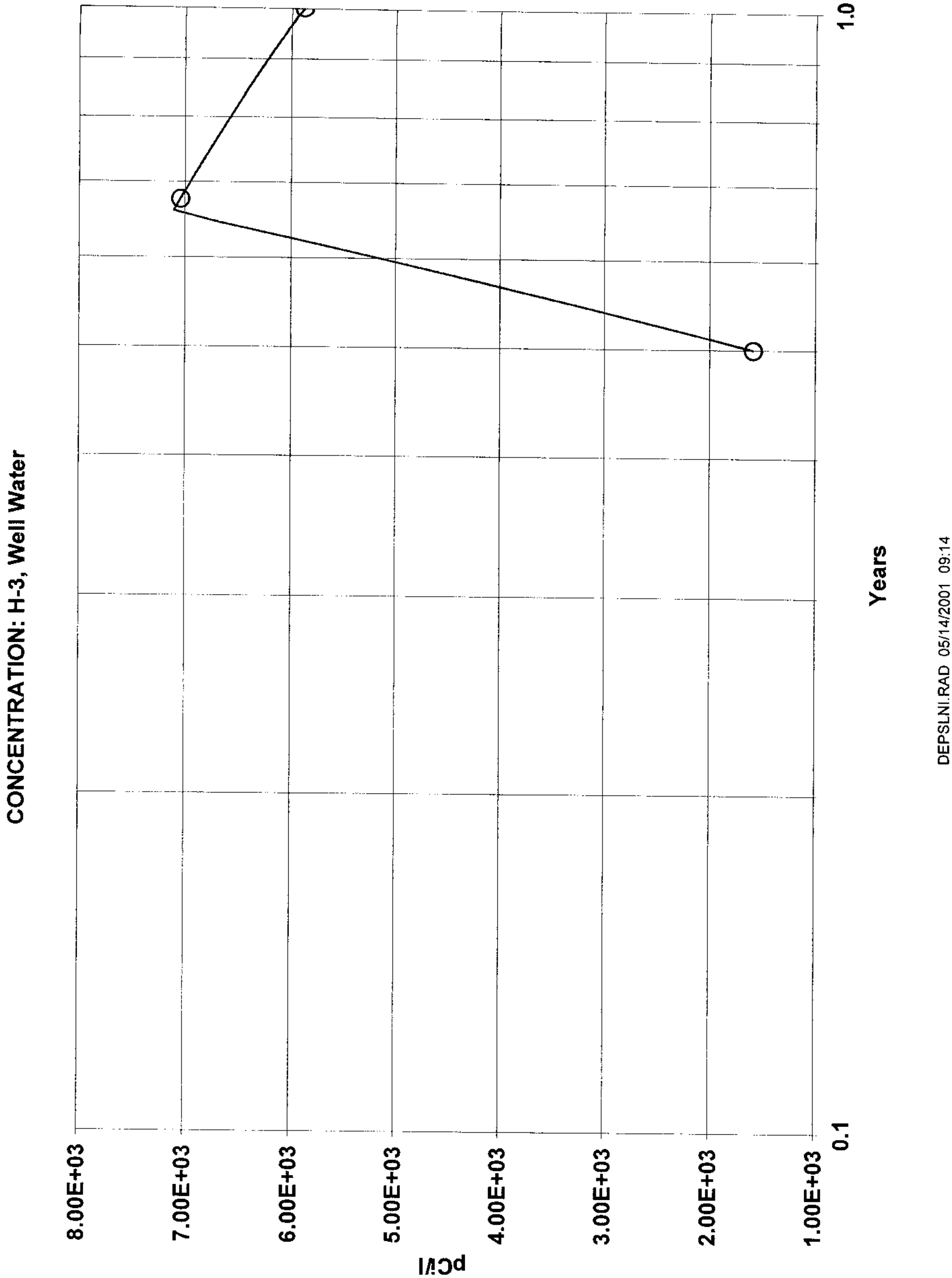
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air = 0.000E+00 pCi/m**3
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air =

Concentration of radionuclides in foodstuff media
at t = 6.760E-01 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
H-3	7.074E+03	1.128E+04	7.672E+03	7.747E+03	8.660E+03	4.166E+03	7.744E+03	7.085E+01	7.085E+01

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.


CONCENTRATION: H-3, Well Water
8.00E+03
7.00E+03
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
pCi/l
0.1
1.0
Years
DEPSLNI.RAD 05/14/2001 09:14

Concentration of radionuclides in environmental media
at t = 1.390E+02 years

Radio-Nuclide	Contaminated Zone	Surface Soil*	Air Particulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
Cs-137	3.113E-02	2.885E-02	1.534E-08	1.113E+00	1.113E-02

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

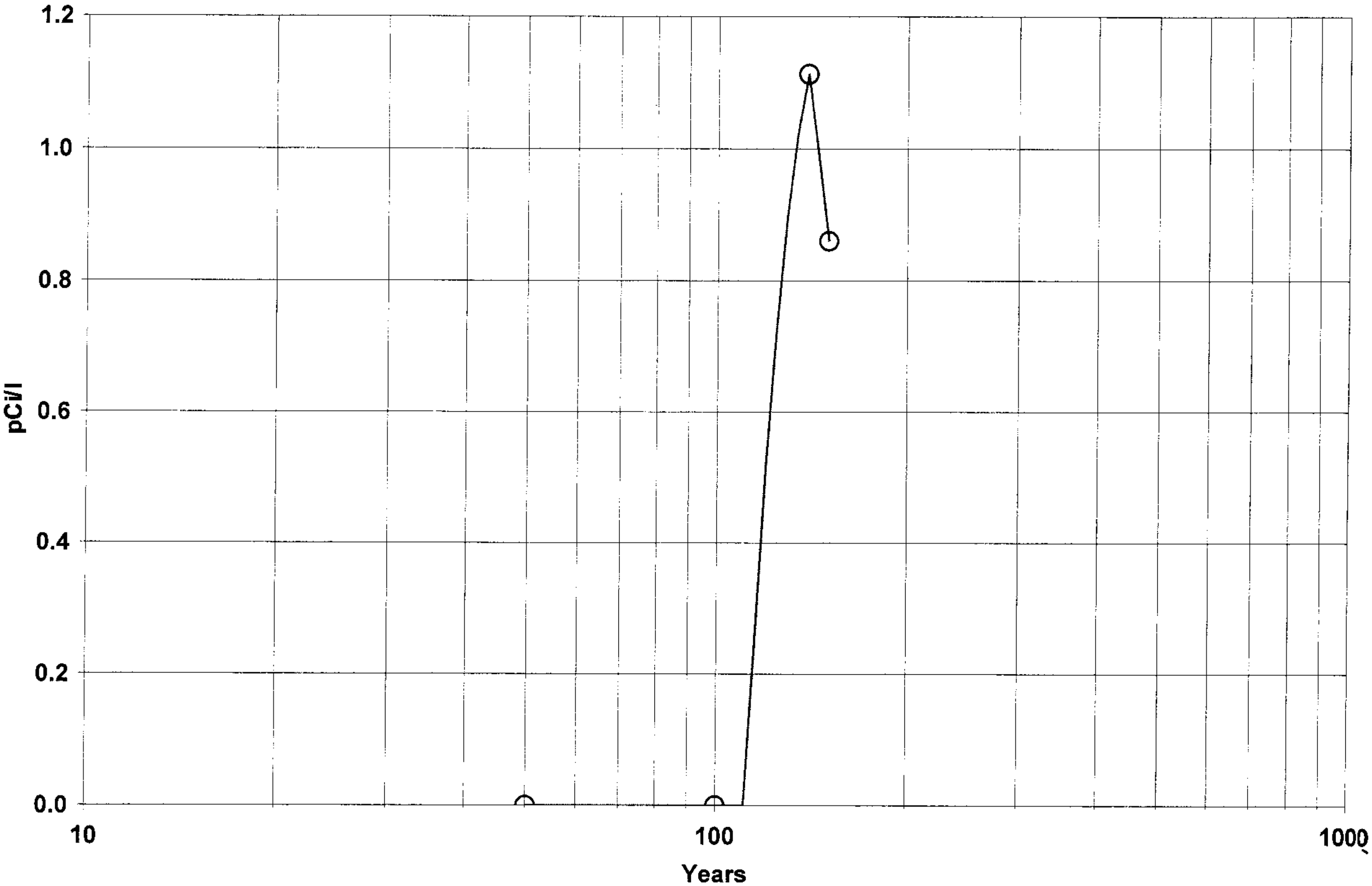
Concentration of radionuclides in foodstuff media
at t = 1.390E+02 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
Cs-137	1.113E+00	1.632E+00	2.930E+00	3.638E+00	3.638E+00	5.053E+00	2.491E+00	2.225E+01	1.112E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

CONCENTRATION: Cs-137, Well Water



DEPSLNI.RAD 05/14/2001 09:26

Attachment 6-10
Buried Piping/Conduit List and Projected Concentration Calculation

Attachment 7, Table 1

Description of Buried Pipe/Conduit	Diam., in.	Length ft.	Surface Area, ft^2	Surface Area, cm^2	Surface Area, m^2	Vol. ft^3	Vol. cm^3	Vol. m^3
Turbine Hall to Sewage Treatment	12	206	647	6.0E+05	60	162	4.6E+06	4.6E+00
Staff Building to Basin West of MH 17	6	52	82	7.6E+04	8	10	2.9E+05	2.9E-01
Staff Building to Basin West of MH 17	10	43	113	1.0E+05	10	23	6.6E+05	6.6E-01
Staff Building to Basin West of MH 17	4	39	41	3.8E+04	4	3	9.6E+04	9.6E-02
Catch Basin West of MH 17 to MH 17	4	55	58	5.4E+04	5	5	1.4E+05	1.4E-01
MH 17 to MH 16	24	45	283	2.6E+05	26	141	4.0E+06	4.0E+00
MH 16 to MH 15	30	55	432	4.0E+05	40	270	7.6E+06	7.6E+00
MH 15 to Back River	30	170	1335	1.2E+06	124	834	2.4E+07	2.4E+01
Wart to Catch Basin East of Staff	4	60	63	5.8E+04	6	5	1.5E+05	1.5E-01
Catch Basin W. of MH 17 to Catch Basin E. of Tunnel	4	75	79	7.3E+04	7	7	1.9E+05	1.9E-01
Catch Basin E. of Staff Tunnel to Catch Basin N. of MH 20	4	26	27	2.5E+04	3	2	6.4E+04	6.4E-02
Warehouse to Catch Basin E. of Staff Tunnel	4	515	539	5.0E+05	50	45	1.3E+06	1.3E+00
Temp Sewer N. of MH 20 to Sewage Treatment Plant	6	340	534	5.0E+05	50	67	1.9E+06	1.9E+00
Temp Sewer N. of MH 20 to Sewage Treatment Plant	8	340	712	6.6E+05	66	119	3.4E+06	3.4E+00
Wart Roof Drain to MH 21	4	37	39	3.6E+04	4	3	9.1E+04	9.1E-02
MH21 to MH 22	15	103	404	3.8E+05	38	126	3.6E+06	3.6E+00
Roof Drain by Road TH to 15" Pipe	10	65	170	1.6E+05	16	35	1.0E+06	1.0E+00
MH 22 to MH 23	18	155	730	6.8E+05	68	274	7.8E+06	7.8E+00
Basin North of TK-16 to MH 23	24	52	327	3.0E+05	30	163	4.6E+06	4.6E+00
MH 23 to MH 24	18	56	264	2.5E+05	25	99	2.8E+06	2.8E+00
MH 24 to MH 27	24	110	691	6.4E+05	64	346	9.8E+06	9.8E+00
Fire Pumphouse Drain to MH 38	4	26	27	2.5E+04	3	2	6.4E+04	6.4E-02
MH 38 to MH 25b	10	86	225	2.1E+05	21	47	1.3E+06	1.3E+00
MH 25b to MH 25a	12	95	298	2.8E+05	28	75	2.1E+06	2.1E+00
MH 25a to MH 26	12	60	188	1.8E+05	18	47	1.3E+06	1.3E+00
MH 26 to MH 27	15	146	573	5.3E+05	53	179	5.1E+06	5.1E+00
WH Bldg. Drain, MH 26 to MH 27	4	404	423	3.9E+05	39	35	1.0E+06	1.0E+00
MH 27 to MH 28	24	190	1194	1.1E+06	111	597	1.7E+07	1.7E+01
MH 28 to MH 29	24	146	917	8.5E+05	85	459	1.3E+07	1.3E+01
MH 29 to West Shoreline	30	50	393	3.6E+05	36	245	6.9E+06	6.9E+00
MH 20 to MH 19	12	133	418	3.9E+05	39	104	3.0E+06	3.0E+00
Roof Drain, NW Corner to MH 19	6	10	16	1.5E+04	1	2	5.6E+04	5.6E-02
MH 19 to MH 18	12	60	188	1.8E+05	18	47	1.3E+06	1.3E+00
Roof Drain, NE Corner to MH 18	6	19	30	2.8E+04	3	4	1.1E+05	1.1E-01
MH 18 to MH5	12	110	346	3.2E+05	32	86	2.4E+06	2.4E+00
Roof Drain E Side of Turbine to MH 4	8	82	172	1.6E+05	16	29	8.1E+05	8.1E-01
MH 4 to MH 5	12	80	251	2.3E+05	23	63	1.8E+06	1.8E+00
MH 5 to Back River	15	200	785	7.3E+05	73	245	6.9E+06	6.9E+00
	Totals	4496	14015	1.3E+07	1302	5008	1.4E+08	1.4E+02

Table 1 is a compilation of the piping and conduit that will remain underground and at depths greater than three feet.

The piping dimensions were provided by Maine Yankee Engineering. The Surface Area was calculated for pipes assuming that they are cylinders using the equation π*D*L, where π*D is the circumference of the cylinder and L is the length. The area was converted to metric units, cm^2 and m^2. The volume of the cylinder is determined using the equation π*r^2*L and was also converted to metric units, cm^3 and m^3.

In its approach to model actual or potential residual radiological constituents Maine Yankee developed unitized dose factors for buried piping and conduit by assuming a unit inventory of 1 dpm/100 cm^2 gross beta radioactivity was present on the internal surfaces. This allows a calculation that ratios the total available gross beta radioactivity to the total volume of the piping. So, if the total surface area of the buried piping is 1.302 E7 cm^2, then the total gross beta radioactivity is 1.302E5 dpm:

$$1.302E7cm^2 * 1dpm/100cm^2 = 1.302E5dpm$$

If this gross beta radioactivity is divided by the total volume (1.42E+08 cm^3), this results in a concentration of 9.182E-4 dpm/cm^3. Using density of 1.6 g/cm3, and converting to pCi, we get a conversion factor of 2.59E-4 pCi/g per dpm/100cm^2. [9.182E-4dpm/cm^3*cm^3/1.6g*pCi/2.22 dpm]. This factor is used in the Buried Pipe and Conduit Worksheet.

Section 6.7.1.c discusses drinking water and irrigation model input parameters-porosity, bulk density, annual drinking water and irrigation rates used in this assessment.

Direct dose conversion factors were determined using the computer code Microshield. The dimension that equated to a volume of soil displaced by the pipes, 141.8 m^3, was calculated for input, assuming that the thickness was one meter (h=1)-

$$\pi * r^2 * h = \text{Volume}$$
$$\pi * r^2 * 1 = 141.8 \text{ m}^3$$
$$\pi * r^2 = 141.8 \text{ m}^2$$
$$r^2 = 45.14 \text{ m}^2$$
$$r = 6.71836 \text{ m}$$

Source dimension having a radius of 671.8 cm and a thickness of 1 meter was used. The depth is assumed to be 1 meter below grade. Unit concentrations (e.g., 1 pCi/g ^{60}Co, ^{57}Co, etc.)of radionuclides were input to Microshield along with a density of 1.6 g/cm^3. The ICRP 51 Deep Dose Equivalent Rate-Rotational was determined by the code. The result was multiplied by the DandD default outdoor occupancy time of 0.1101 years or 964 hours. The direct dose factors are listed in the following tables.

Nuclide	Microshield Deep Dose Equivalent Rate-Rotational mSv/h	mrem/hr	Hours/year	mrem/year
Cs-134	2.291E-10	2.291E-8	964	2.21E-05
Cs-137	4.121E-11	4.121E-9	964	3.97E-06
Co-60	2.624E-9	2.624E-7	964	2.53E-04
Co-57	9.789E-14	9.789E-12	964	9.44E-09

Attachment 6-11
Buried Piping/Conduit RESRAD Output

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
File: Default.LIB

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	H-3	6.400E-08	6.400E-08	DCF2(1)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	H-3	6.400E-08	6.400E-08	DCF3(1)
D-34	Food transfer factors:			
D-34	H-3 , plant/soil concentration ratio, dimensionless	4.800E+00	4.800E+00	RTF(1,1)
D-34	H-3 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.200E-02	1.200E-02	RTF(1,2)
D-34	H-3 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-02	1.000E-02	RTF(1,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	H-3 , fish	1.000E+00	1.000E+00	BIOFAC(1,1)
D-5	H-3 , crustacea and mollusks	1.000E+00	1.000E+00	BIOFAC(1,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R011	Area of contaminated zone (m**2)	1.420E+02	1.000E+04	---
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---
R011	Basic radiation dose limit (mrem/yr)	1.000E+01	3.000E+01	---
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---
R011	Times for calculations (yr)	4.000E+01	3.000E+00	---
R011	Times for calculations (yr)	5.000E+01	1.000E+01	---
R011	Times for calculations (yr)	1.000E+02	3.000E+01	---
R011	Times for calculations (yr)	3.000E+02	1.000E+02	---
R011	Times for calculations (yr)	1.000E+03	3.000E+02	---
R011	Times for calculations (yr)	not used	1.000E+03	---
R011	Times for calculations (yr)	not used	0.000E+00	---
R011	Times for calculations (yr)	not used	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): H-3	1.000E+00	0.000E+00	---
R012	Concentration in groundwater (pCi/L): H-3	not used	0.000E+00	---
R013	Cover depth (m)	1.000E+00	0.000E+00	---
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---
R013	Contaminated zone total porosity	3.000E-01	4.000E-01	---
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---
R013	Contaminated zone hydraulic conductivity (m/yr)	3.200E+01	1.000E+01	---
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---
R013	Humidity in air (g/m**3)	not used	8.000E+00	---
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---
R013	Irrigation mode	overhead	overhead	---
R013	Runoff coefficient	2.000E-01	2.000E-01	---
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---
R014	Saturated zone effective porosity	1.000E-02	2.000E-01	---
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---
R014	Saturated zone hydraulic conductivity (m/yr)	3.200E+01	1.000E+02	---
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---
R015	Number of unsaturated zone strata	1	1	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R015	Unsat. zone 1, thickness (m)	3.000E+00	4.000E+00	---
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+03	1.000E+01	---
R016	Distribution coefficients for H-3			
R016	Contaminated zone (cm**3/g)	0.000E+00	0.000E+00	---
R016	Unsaturated zone 1 (cm**3/g)	0.000E+00	0.000E+00	---
R016	Saturated zone (cm**3/g)	0.000E+00	0.000E+00	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	2.424E+00
R016	Solubility constant	0.000E+00	0.000E+00	not used
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---
R017	Exposure duration	3.000E+01	3.000E+01	---
R017	Shielding factor, inhalation	not used	4.000E-01	---
R017	Shielding factor, external gamma	not used	7.000E-01	---
R017	Fraction of time spent indoors	not used	5.000E-01	---
R017	Fraction of time spent outdoors (on site)	not used	2.500E-01	---
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular ARE
R017	Radii of shape factor array (used if FS = -1):			
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---
R017	Fractions of annular areas within AREA:			
R017	Ring 1	not used	1.000E+00	---
R017	Ring 2	not used	2.732E-01	---
R017	Ring 3	not used	0.000E+00	---
R017	Ring 4	not used	0.000E+00	---
R017	Ring 5	not used	0.000E+00	---
R017	Ring 6	not used	0.000E+00	---
R017	Ring 7	not used	0.000E+00	---
R017	Ring 8	not used	0.000E+00	---
R017	Ring 9	not used	0.000E+00	---
R017	Ring 10	not used	0.000E+00	---
R017	Ring 11	not used	0.000E+00	---
R017	Ring 12	not used	0.000E+00	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---
R018	Milk consumption (L/yr)	not used	9.200E+01	---
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---
R018	Fish consumption (kg/yr)	not used	5.400E+00	---
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---
R018	Soil ingestion rate (g/yr)	not used	3.650E+01	---
R018	Drinking water intake (L/yr)	4.785E+02	5.100E+02	---
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---
R018	Contamination fraction of household water	not used	1.000E+00	---
R018	Contamination fraction of livestock water	not used	1.000E+00	---
R018	Contamination fraction of irrigation water	not used	1.000E+00	---
R018	Contamination fraction of aquatic food	not used	5.000E-01	---
R018	Contamination fraction of plant food	not used	-1	---
R018	Contamination fraction of meat	not used	-1	---
R018	Contamination fraction of milk	not used	-1	---
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---
R019	Depth of soil mixing layer (m)	not used	1.500E-01	---
R019	Depth of roots (m)	not used	9.000E-01	---
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---
R019	Household water fraction from ground water	not used	1.000E+00	---
R019	Livestock water fraction from ground water	not used	1.000E+00	---
R019	Irrigation fraction from ground water	not used	1.000E+00	---
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---
R19B	Translocation Factor for Leafy	not used	1.000E+00	---
R19B	Translocation Factor for Fodder	not used	1.000E+00	---
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---
STOR	Storage times of contaminated foodstuffs (days):			
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---
STOR	Leafy vegetables	1.000E+00	1.000E+00	---
STOR	Milk	1.000E+00	1.000E+00	---
STOR	Meat and poultry	2.000E+01	2.000E+01	---
STOR	Fish	7.000E+00	7.000E+00	---
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---
STOR	Well water	1.000E+00	1.000E+00	---
STOR	Surface water	1.000E+00	1.000E+00	---
STOR	Livestock fodder	0.000E+00	4.500E+01	---
R021	Thickness of building foundation (m)	not used	1.500E-01	---
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---
R021	Total porosity of the cover material	not used	4.000E-01	---
R021	Total porosity of the building foundation	not used	1.000E-01	---
R021	Volumetric water content of the cover material	not used	5.000E-02	---
R021	Volumetric water content of the foundation	not used	3.000E-02	---
R021	Diffusion coefficient for radon gas (m/sec):			
R021	in cover material	not used	2.000E-06	---
R021	in foundation material	not used	3.000E-07	---
R021	in contaminated zone soil	not used	2.000E-06	---
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---
R021	Height of the building (room) (m)	not used	2.500E+00	---
R021	Building interior area factor	not used	0.000E+00	---
R021	Building depth below ground surface (m)	not used	-1.000E+00	---
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---
TITL	Number of graphical time points	32	---	---
TITL	Maximum number of integration points for dose	1	---	---
TITL	Maximum number of integration points for risk	17	---	---

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	suppressed
2 -- inhalation (w/o radon)	suppressed
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	suppressed
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contaminated Zone Dimensions

Area: 142.00 square meters
Thickness: 1.00 meters
Cover Depth: 1.00 meters

Initial Soil Concentrations, pCi/g

H-3 1.000E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 10 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	4.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
TDOSE(t):	0.000E+00	4.943E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
M(t):	0.000E+00	4.943E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

Maximum TDOSE(t): 6.439E-03 mrem/yr at t = 0.886 ñ 0.002 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 8.865E-01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 8.865E-01 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
H-3	6.439E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	6.439E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Mi
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Mi
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
H-3	4.943E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	4.943E-03	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 4.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Mi
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 4.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Mi
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground		Inhalation		Radon		Plant		Meat		Mi
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water		Fish		Radon		Plant		Meat		Mi
	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
H-3	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	4.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
			DSR(j,t) (mrem/yr)/(pCi/g)						
H-3	H-3	1.000E+00	0.000E+00	4.943E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)
The DSR includes contributions from associated (half-life ó 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 10 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	4.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
H-3	*9.594E+15	2.023E+03	*9.594E+15	*9.594E+15	*9.594E+15	*9.594E+15	*9.594E+15

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.886 ñ 0.002 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
H-3	1.000E+00	0.886 ñ 0.002	6.439E-03	1.553E+03	6.439E-03	1.553E+03

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

Nuclide (i)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	4.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
			DOSE(j,t), mrem/yr						
H-3	H-3	1.000E+00	0.000E+00	4.943E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	4.000E+01	5.000E+01	1.000E+02	3.000E+02	1.000E+03
			S(j,t), pCi/g						
H-3	H-3	1.000E+00	1.000E+00	8.372E-02	8.128E-44	0.000E+00	0.000E+00	0.000E+00	0.000E+00

BRF(i) is the branch fraction of the parent nuclide.

RESMAIN5.EXE execution time = 236.45 seconds

Table of Contents

Part IV: Concentration of Radionuclides

Concentration of radionuclides in environmental media
at t = 0.000E+00 years

Radio-Nuclide	Contaminated Zone	Surface Soil*	Air Particulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
H-3	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air = 0.000E+00 pCi/m**3
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air =

Concentration of radionuclides in foodstuff media
at t = 0.000E+00 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 1.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
H-3	8.372E-02	0.000E+00	0.000E+00	1.603E+02	6.263E-01

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air = 0.000E+00 pCi/m**3
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air =

Concentration of radionuclides in foodstuff media
at t = 1.000E+00 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
H-3	1.614E+02	1.830E+02	9.525E+01	1.281E+02	1.126E+02	1.060E+02	1.342E+02	6.561E-01	6.561E-01

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 4.000E+01 years

Radio-Nuclide	Contaminated Zone	Surface Soil*	Air Particulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
H-3	8.128E-44	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air = 0.000E+00 pCi/m**3
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air =

Concentration of radionuclides in foodstuff media
at t = 4.000E+01 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Attachment 6-11
Page 23 of 60

Concentration of radionuclides in environmental media
at t = 5.000E+01 years

Radio-Nuclide	Contaminated Zone	Surface Soil*	Air Particulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters,
i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air = 0.000E+00 pCi/m**3
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air =

Concentration of radionuclides in foodstuff media
at t = 5.000E+01 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters,
i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 1.000E+02 years

Radio-Nuclide	Contaminated Zone	Surface Soil*	Air Particulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air = 0.000E+00 pCi/m**3
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air =

Concentration of radionuclides in foodstuff media
at t = 1.000E+02 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 3.000E+02 years

Radio-Nuclide	Contaminated Zone	Surface Soil*	Air Particulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters,
i.e. using parameters appearing in the input screen when the pathways are active.
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air = 0.000E+00 pCi/m**3
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air =

Concentration of radionuclides in foodstuff media
at t = 3.000E+02 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters,
i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 1.000E+03 years

Radio-Nuclide	Contaminated Zone	Surface Soil*	Air Particulate	Well Water	Surface Water
	pCi/g	pCi/g	pCi/m**3	pCi/l	pCi/l
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air = 0.000E+00 pCi/m**3
Concentration of H-3 in soil moisture = 0.000E+00 pCi/ml
Concentration of gaseous H-3 in air =

Concentration of radionuclides in foodstuff media
at t = 1.000E+03 years*

Radio-Nuclide	Drinking Water	Nonleafy Vegetable	Leafy Vegetable	Fodder Meat	Fodder Milk	Meat	Milk	Fish	Crustacea
	pCi/l	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/kg	pCi/l	pCi/kg	pCi/kg
H-3	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
File: Default.LIB

Menu	Parameter	Current Value	Default	Parameter Name
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Co-57	9.070E-06	9.070E-06	DCF2(1)
B-1	Co-60	2.190E-04	2.190E-04	DCF2(2)
B-1	Cs-134	4.630E-05	4.630E-05	DCF2(3)
B-1	Cs-137+D	3.190E-05	3.190E-05	DCF2(4)
B-1	Fe-55	2.690E-06	2.690E-06	DCF2(5)
B-1	Ni-63	6.290E-06	6.290E-06	DCF2(6)
B-1	Sr-90+D	1.310E-03	1.310E-03	DCF2(7)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Co-57	1.180E-06	1.180E-06	DCF3(1)
D-1	Co-60	2.690E-05	2.690E-05	DCF3(2)
D-1	Cs-134	7.330E-05	7.330E-05	DCF3(3)
D-1	Cs-137+D	5.000E-05	5.000E-05	DCF3(4)
D-1	Fe-55	6.070E-07	6.070E-07	DCF3(5)
D-1	Ni-63	5.770E-07	5.770E-07	DCF3(6)
D-1	Sr-90+D	1.530E-04	1.530E-04	DCF3(7)
D-34	Food transfer factors:			
D-34	Co-57 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(1,1)
D-34	Co-57 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(1,2)
D-34	Co-57 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(1,3)
D-34				
D-34	Co-60 , plant/soil concentration ratio, dimensionless	8.000E-02	8.000E-02	RTF(2,1)
D-34	Co-60 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(2,2)
D-34	Co-60 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(2,3)
D-34				
D-34	Cs-134 , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(3,1)
D-34	Cs-134 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(3,2)
D-34	Cs-134 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(3,3)
D-34				
D-34	Cs-137+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Cs-137+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.000E-02	3.000E-02	RTF(4,2)
D-34	Cs-137+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	8.000E-03	8.000E-03	RTF(4,3)
D-34				
D-34	Fe-55 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Fe-55 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-02	2.000E-02	RTF(5,2)
D-34	Fe-55 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(5,3)
D-34				
D-34	Ni-63 , plant/soil concentration ratio, dimensionless	5.000E-02	5.000E-02	RTF(6,1)
D-34	Ni-63 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(6,2)
D-34	Ni-63 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-02	2.000E-02	RTF(6,3)
D-34				
D-34	Sr-90+D , plant/soil concentration ratio, dimensionless	3.000E-01	3.000E-01	RTF(7,1)
D-34	Sr-90+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-03	8.000E-03	RTF(7,2)
D-34	Sr-90+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-03	2.000E-03	RTF(7,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Co-57 , fish	3.000E+02	3.000E+02	BIOFAC(1,1)
D-5	Co-57 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(1,2)
D-5				

Dose Conversion Factor (and Related) Parameter Summary (continued)
File: Default.LIB

Menu	Parameter	Current Value	Default	Parameter Name
D-5	Co-60 , fish	3.000E+02	3.000E+02	BIOFAC(2,1)
D-5	Co-60 , crustacea and mollusks	2.000E+02	2.000E+02	BIOFAC(2,2)
D-5				
D-5	Cs-134 , fish	2.000E+03	2.000E+03	BIOFAC(3,1)
D-5	Cs-134 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)
D-5				
D-5	Cs-137+D , fish	2.000E+03	2.000E+03	BIOFAC(4,1)
D-5	Cs-137+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(4,2)
D-5				
D-5	Fe-55 , fish	2.000E+02	2.000E+02	BIOFAC(5,1)
D-5	Fe-55 , crustacea and mollusks	3.200E+03	3.200E+03	BIOFAC(5,2)
D-5				
D-5	Ni-63 , fish	1.000E+02	1.000E+02	BIOFAC(6,1)
D-5	Ni-63 , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(6,2)
D-5				
D-5	Sr-90+D , fish	6.000E+01	6.000E+01	BIOFAC(7,1)
D-5	Sr-90+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(7,2)

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R011	Area of contaminated zone (m**2)	1.420E+02	1.000E+04	---
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---
R011	Length parallel to aquifer flow (m)	1.000E+02	1.000E+02	---
R011	Basic radiation dose limit (mrem/yr)	1.000E+01	3.000E+01	---
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---
R011	Times for calculations (yr)	5.000E+01	1.000E+02	---
R011	Times for calculations (yr)	1.000E+02	3.000E+02	---
R011	Times for calculations (yr)	3.000E+02	1.000E+03	---
R011	Times for calculations (yr)	5.000E+02	0.000E+00	---
R011	Times for calculations (yr)	1.000E+03	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): Co-57	1.000E+00	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): Co-60	1.000E+00	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): Cs-134	1.000E+00	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): Cs-137	1.000E+00	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): Fe-55	1.000E+00	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): Ni-63	1.000E+00	0.000E+00	---
R012	Initial principal radionuclide (pCi/g): Sr-90	1.000E+00	0.000E+00	---
R012	Concentration in groundwater (pCi/L): Co-57	not used	0.000E+00	---
R012	Concentration in groundwater (pCi/L): Co-60	not used	0.000E+00	---
R012	Concentration in groundwater (pCi/L): Cs-134	not used	0.000E+00	---
R012	Concentration in groundwater (pCi/L): Cs-137	not used	0.000E+00	---
R012	Concentration in groundwater (pCi/L): Fe-55	not used	0.000E+00	---
R012	Concentration in groundwater (pCi/L): Ni-63	not used	0.000E+00	---
R012	Concentration in groundwater (pCi/L): Sr-90	not used	0.000E+00	---
R013	Cover depth (m)	1.000E+00	0.000E+00	---
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---
R013	Cover depth erosion rate (m/yr)	1.000E-03	1.000E-03	---
R013	Density of contaminated zone (g/cm**3)	1.600E+00	1.500E+00	---
R013	Contaminated zone erosion rate (m/yr)	1.000E-03	1.000E-03	---
R013	Contaminated zone total porosity	3.000E-01	4.000E-01	---
R013	Contaminated zone field capacity	2.000E-01	2.000E-01	---
R013	Contaminated zone hydraulic conductivity (m/yr)	3.200E+01	1.000E+01	---
R013	Contaminated zone b parameter	4.050E+00	5.300E+00	---
R013	Average annual wind speed (m/sec)	2.000E+00	2.000E+00	---
R013	Humidity in air (g/m**3)	not used	8.000E+00	---
R013	Evapotranspiration coefficient	5.000E-01	5.000E-01	---
R013	Precipitation (m/yr)	1.000E+00	1.000E+00	---
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---
R013	Irrigation mode	overhead	overhead	---
R013	Runoff coefficient	2.000E-01	2.000E-01	---
R013	Watershed area for nearby stream or pond (m**2)	1.000E+06	1.000E+06	---
R013	Accuracy for water/soil computations	1.000E-03	1.000E-03	---
R014	Density of saturated zone (g/cm**3)	1.600E+00	1.500E+00	---
R014	Saturated zone total porosity	4.000E-01	4.000E-01	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R014	Saturated zone effective porosity	1.000E-02	2.000E-01	---
R014	Saturated zone field capacity	2.000E-01	2.000E-01	---
R014	Saturated zone hydraulic conductivity (m/yr)	3.200E+01	1.000E+02	---
R014	Saturated zone hydraulic gradient	2.000E-02	2.000E-02	---
R014	Saturated zone b parameter	5.300E+00	5.300E+00	---
R014	Water table drop rate (m/yr)	1.000E-03	1.000E-03	---
R014	Well pump intake depth (m below water table)	1.000E+01	1.000E+01	---
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	ND	ND	---
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---
R015	Number of unsaturated zone strata	1	1	---
R015	Unsat. zone 1, thickness (m)	3.000E+00	4.000E+00	---
R015	Unsat. zone 1, soil density (g/cm**3)	1.600E+00	1.500E+00	---
R015	Unsat. zone 1, total porosity	4.000E-01	4.000E-01	---
R015	Unsat. zone 1, effective porosity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, field capacity	2.000E-01	2.000E-01	---
R015	Unsat. zone 1, soil-specific b parameter	5.300E+00	5.300E+00	---
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	1.000E+03	1.000E+01	---
R016	Distribution coefficients for Co-57			
R016	Contaminated zone (cm**3/g)	9.400E+00	1.000E+03	---
R016	Unsaturated zone 1 (cm**3/g)	9.400E+00	1.000E+03	---
R016	Saturated zone (cm**3/g)	9.400E+00	1.000E+03	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.279E-02
R016	Solubility constant	0.000E+00	0.000E+00	not used
R016	Distribution coefficients for Co-60			
R016	Contaminated zone (cm**3/g)	9.400E+00	1.000E+03	---
R016	Unsaturated zone 1 (cm**3/g)	9.400E+00	1.000E+03	---
R016	Saturated zone (cm**3/g)	9.400E+00	1.000E+03	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.279E-02
R016	Solubility constant	0.000E+00	0.000E+00	not used
R016	Distribution coefficients for Cs-134			
R016	Contaminated zone (cm**3/g)	3.460E+01	1.000E+03	---
R016	Unsaturated zone 1 (cm**3/g)	3.460E+01	1.000E+03	---
R016	Saturated zone (cm**3/g)	3.460E+01	1.000E+03	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.998E-03
R016	Solubility constant	0.000E+00	0.000E+00	not used
R016	Distribution coefficients for Cs-137			
R016	Contaminated zone (cm**3/g)	3.460E+01	1.000E+03	---
R016	Unsaturated zone 1 (cm**3/g)	3.460E+01	1.000E+03	---
R016	Saturated zone (cm**3/g)	3.460E+01	1.000E+03	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	8.998E-03
R016	Solubility constant	0.000E+00	0.000E+00	not used

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R016	Distribution coefficients for Fe-55			
R016	Contaminated zone (cm**3/g)	1.000E+03	1.000E+03	---
R016	Unsaturated zone 1 (cm**3/g)	1.000E+03	1.000E+03	---
R016	Saturated zone (cm**3/g)	1.000E+03	1.000E+03	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.125E-04
R016	Solubility constant	0.000E+00	0.000E+00	not used
R016	Distribution coefficients for Ni-63			
R016	Contaminated zone (cm**3/g)	8.000E+00	1.000E+03	---
R016	Unsaturated zone 1 (cm**3/g)	8.000E+00	1.000E+03	---
R016	Saturated zone (cm**3/g)	8.000E+00	1.000E+03	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	3.844E-02
R016	Solubility constant	0.000E+00	0.000E+00	not used
R016	Distribution coefficients for Sr-90			
R016	Contaminated zone (cm**3/g)	4.400E+00	3.000E+01	---
R016	Unsaturated zone 1 (cm**3/g)	4.400E+00	3.000E+01	---
R016	Saturated zone (cm**3/g)	4.400E+00	3.000E+01	---
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.900E-02
R016	Solubility constant	0.000E+00	0.000E+00	not used
R017	Inhalation rate (m**3/yr)	not used	8.400E+03	---
R017	Mass loading for inhalation (g/m**3)	not used	1.000E-04	---
R017	Exposure duration	3.000E+01	3.000E+01	---
R017	Shielding factor, inhalation	not used	4.000E-01	---
R017	Shielding factor, external gamma	not used	7.000E-01	---
R017	Fraction of time spent indoors	not used	5.000E-01	---
R017	Fraction of time spent outdoors (on site)	not used	2.500E-01	---
R017	Shape factor flag, external gamma	not used	1.000E+00	>0 shows circular ARE
R017	Radii of shape factor array (used if FS = -1):			
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R017	Fractions of annular areas within AREA:			
R017	Ring 1	not used	1.000E+00	---
R017	Ring 2	not used	2.732E-01	---
R017	Ring 3	not used	0.000E+00	---
R017	Ring 4	not used	0.000E+00	---
R017	Ring 5	not used	0.000E+00	---
R017	Ring 6	not used	0.000E+00	---
R017	Ring 7	not used	0.000E+00	---
R017	Ring 8	not used	0.000E+00	---
R017	Ring 9	not used	0.000E+00	---
R017	Ring 10	not used	0.000E+00	---
R017	Ring 11	not used	0.000E+00	---
R017	Ring 12	not used	0.000E+00	---
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---
R018	Milk consumption (L/yr)	not used	9.200E+01	---
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---
R018	Fish consumption (kg/yr)	not used	5.400E+00	---
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---
R018	Soil ingestion rate (g/yr)	not used	3.650E+01	---
R018	Drinking water intake (L/yr)	4.785E+02	5.100E+02	---
R018	Contamination fraction of drinking water	1.000E+00	1.000E+00	---
R018	Contamination fraction of household water	not used	1.000E+00	---
R018	Contamination fraction of livestock water	not used	1.000E+00	---
R018	Contamination fraction of irrigation water	not used	1.000E+00	---
R018	Contamination fraction of aquatic food	not used	5.000E-01	---
R018	Contamination fraction of plant food	not used	-1	---
R018	Contamination fraction of meat	not used	-1	---
R018	Contamination fraction of milk	not used	-1	---
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---
R019	Depth of soil mixing layer (m)	not used	1.500E-01	---
R019	Depth of roots (m)	not used	9.000E-01	---
R019	Drinking water fraction from ground water	1.000E+00	1.000E+00	---
R019	Household water fraction from ground water	not used	1.000E+00	---
R019	Livestock water fraction from ground water	not used	1.000E+00	---
R019	Irrigation fraction from ground water	not used	1.000E+00	---
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user
R19B	Translocation Factor for Leafy	not used	1.000E+00	---
R19B	Translocation Factor for Fodder	not used	1.000E+00	---
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---
STOR	Storage times of contaminated foodstuffs (days):			
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---
STOR	Leafy vegetables	1.000E+00	1.000E+00	---
STOR	Milk	1.000E+00	1.000E+00	---
STOR	Meat and poultry	2.000E+01	2.000E+01	---
STOR	Fish	7.000E+00	7.000E+00	---
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---
STOR	Well water	1.000E+00	1.000E+00	---
STOR	Surface water	1.000E+00	1.000E+00	---
STOR	Livestock fodder	0.000E+00	4.500E+01	---
R021	Thickness of building foundation (m)	not used	1.500E-01	---
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---
R021	Total porosity of the cover material	not used	4.000E-01	---
R021	Total porosity of the building foundation	not used	1.000E-01	---
R021	Volumetric water content of the cover material	not used	5.000E-02	---
R021	Volumetric water content of the foundation	not used	3.000E-02	---
R021	Diffusion coefficient for radon gas (m/sec):			
R021	in cover material	not used	2.000E-06	---
R021	in foundation material	not used	3.000E-07	---
R021	in contaminated zone soil	not used	2.000E-06	---
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---
R021	Height of the building (room) (m)	not used	2.500E+00	---
R021	Building interior area factor	not used	0.000E+00	---
R021	Building depth below ground surface (m)	not used	-1.000E+00	---
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---
TITL	Number of graphical time points	32	---	---
TITL	Maximum number of integration points for dose	1	---	---
TITL	Maximum number of integration points for risk	17	---	---

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	suppressed
2 -- inhalation (w/o radon)	suppressed
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	active
8 -- soil ingestion	suppressed
9 -- radon	suppressed
Find peak pathway doses	suppressed

Contamináted Zone Dimensions

Area:	142.00 square meters
Thickness:	1.00 meters
Cover Depth:	1.00 meters

Initial Soil Concentrations, pCi/g

Co-57	1.000E+00
Co-60	1.000E+00
Cs-134	1.000E+00
Cs-137	1.000E+00
Fe-55	1.000E+00
Ni-63	1.000E+00
Sr-90	1.000E+00

Total Dose TDOSE(t), mrem/yr
Basic Radiation Dose Limit = 10 mrem/yr
Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02	5.0
TDOSE(t):	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.865E-01	2.985E-02	3.478E-04	8.452E-06	1.3
M(t):	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.865E-02	2.985E-03	3.478E-05	8.452E-07	1.3

Maximum TDOSE(t): 2.820E-01 mrem/yr at t = 25.54 ñ 0.05 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 2.554E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 2.554E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	2.820E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	2.820E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	1.865E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	1.865E-01	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 5.000E+01 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
Co-57	5.514E-24	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	3.444E-05	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	6.448E-04	0.0216	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	2.917E-02	0.9772	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	2.985E-02	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	1.843E-08	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	6.582E-05	0.1892	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	2.820E-04	0.8107	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	3.478E-04	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	9.931E-23	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	8.445E-06	0.9992	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	7.150E-09	0.0008	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	2.464E-12	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	8.452E-06	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 5.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Mi
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	1.381E-08	0.9999	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	7.767E-13	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	2.152E-20	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	1.382E-08	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-Nuclide	Ground mrem/yr	Ground fract.	Inhalation mrem/yr	Inhalation fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-Nuclide	Water mrem/yr	Water fract.	Fish mrem/yr	Fish fract.	Radon mrem/yr	Radon fract.	Plant mrem/yr	Plant fract.	Meat mrem/yr	Meat fract.	Mi mrem/yr
Co-57	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Co-60	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-134	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Cs-137	1.495E-15	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Fe-55	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Ni-63	9.550E-23	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Sr-90	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0
Total	1.495E-15	1.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+0

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways
Parent and Progeny Principal Radionuclide Contributions Indicated

DSR(j,t) (mrem/yr)/(pCi/g)

Parent (i)	Product (j)	Branch Fraction*	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+
Co-57	Co-57	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.514E-24	1.121E-44	0.000E+
Co-60	Co-60	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.444E-05	1.843E-08	9.931E-
Cs-134	Cs-134	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+
Cs-137	Cs-137	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.445E-
Fe-55	Fe-55	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+
Ni-63	Ni-63	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.448E-04	6.582E-05	7.150E-
Sr-90	Sr-90	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.865E-01	2.917E-02	2.820E-04	2.464E-

*Branch Fraction is the cumulative factor for the j't principal radionuclide daughter: CUMBRF(j) = BRF(1)
The DSR includes contributions from associated (half-life ó 0.5 yr) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 10 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+02
Co-57	*8.464E+15	*8.464E+15	*8.464E+15	*8.464E+15	*8.464E+15	*8.464E+15	*8.464E+15	*8.464E+15
Co-60	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	*1.131E+15	2.904E+05	5.427E+08	*1.131E+15
Cs-134	*1.294E+15	*1.294E+15	*1.294E+15	*1.294E+15	*1.294E+15	*1.294E+15	*1.294E+15	*1.294E+15
Cs-137	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	*8.701E+13	1.184E+06
Fe-55	*2.409E+15	*2.409E+15	*2.409E+15	*2.409E+15	*2.409E+15	*2.409E+15	*2.409E+15	*2.409E+15
Ni-63	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13	*5.916E+13	1.551E+04	1.519E+05	1.399E+09
Sr-90	*1.365E+14	*1.365E+14	*1.365E+14	*1.365E+14	5.361E+01	3.428E+02	3.546E+04	4.059E+12

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 25.54 ñ 0.05 years

Nuclide (i)	Initial pCi/g	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Co-57	1.000E+00	46.87 ñ 0.09	2.669E-23	*8.464E+15	0.000E+00	*8.464E+15
Co-60	1.000E+00	52.6 ñ 0.1	3.816E-05	2.620E+05	0.000E+00	*1.131E+15
Cs-134	1.000E+00	0.000E+00	0.000E+00	*1.294E+15	0.000E+00	*1.294E+15
Cs-137	1.000E+00	195.1 ñ 0.4	2.435E-04	4.106E+04	0.000E+00	*8.701E+13
Fe-55	1.000E+00	0.000E+00	0.000E+00	*2.409E+15	0.000E+00	*2.409E+15
Ni-63	1.000E+00	45.74 ñ 0.09	7.831E-04	1.277E+04	0.000E+00	*5.916E+13
Sr-90	1.000E+00	25.54 ñ 0.05	2.820E-01	3.546E+01	2.820E-01	3.546E+01

*At specific activity limit

Individual Nuclide Dose Summed Over All Pathways
Parent Nuclide and Branch Fraction Indicated

DOSE(j,t), mrem/yr

Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+
Co-57	Co-57	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	5.514E-24	0.000E+00	0.000E+
Co-60	Co-60	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	3.444E-05	1.843E-08	9.931E-
Cs-134	Cs-134	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+
Cs-137	Cs-137	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	8.445E-
Fe-55	Fe-55	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+
Ni-63	Ni-63	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	6.448E-04	6.582E-05	7.150E-
Sr-90	Sr-90	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.865E-01	2.917E-02	2.820E-04	2.464E-

BRF(i) is the branch fraction of the parent nuclide.

Individual Nuclide Soil Concentration
Parent Nuclide and Branch Fraction Indicated

S(j,t), pCi/g

Nuclide (j)	Parent (i)	BRF(i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	5.000E+01	1.000E+02	3.000E+
Co-57	Co-57	1.000E+00	1.000E+00	3.801E-01	5.491E-02	6.294E-05	2.493E-13	9.877E-22	9.753E-43	0.000E+
Co-60	Co-60	1.000E+00	1.000E+00	8.485E-01	6.109E-01	1.934E-01	7.234E-03	2.706E-04	7.323E-08	3.927E-
Cs-134	Cs-134	1.000E+00	1.000E+00	7.081E-01	3.551E-01	3.170E-02	3.185E-05	3.200E-08	1.024E-15	1.401E-
Cs-137	Cs-137	1.000E+00	1.000E+00	9.684E-01	9.082E-01	7.254E-01	3.817E-01	2.009E-01	4.034E-02	6.566E-
Fe-55	Fe-55	1.000E+00	1.000E+00	7.733E-01	4.625E-01	7.651E-02	4.479E-04	2.622E-06	6.873E-12	3.247E-
Ni-63	Ni-63	1.000E+00	1.000E+00	9.554E-01	8.720E-01	6.334E-01	2.541E-01	1.020E-01	1.040E-02	1.124E-
Sr-90	Sr-90	1.000E+00	1.000E+00	9.114E-01	7.570E-01	3.953E-01	6.178E-02	9.656E-03	9.323E-05	8.104E-

BRF(i) is the branch fraction of the parent nuclide.

RESMAIN5.EXE execution time = 1304.48 seconds

Table of Contents

Part IV: Concentration of Radionuclides

Concentration of radionuclides in environmental media
at t = 0.000E+00 years

Radio- Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Co-57	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	1.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 0.000E+00 years*

Radio- Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Co-57	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 1.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Co-57	3.801E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	8.485E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	7.081E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	9.684E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	7.733E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	9.554E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	9.114E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+00 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Co-57	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 3.000E+00 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Co-57	5.491E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	6.109E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	3.551E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	9.082E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	4.625E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	8.720E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	7.570E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.000E+00 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Co-57	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 1.000E+01 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Co-57	6.294E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	1.934E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	3.170E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	7.254E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	7.651E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	6.334E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	3.953E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+01 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Co-57	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 3.000E+01 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Co-57	2.493E-13	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	7.234E-03	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	3.185E-05	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	3.817E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	4.479E-04	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	2.541E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	6.178E-02	0.000E+00	0.000E+00	2.548E+00	9.951E-03

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.000E+01 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Co-57	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Sr-90	2.548E+00	1.033E+00	3.947E+00	5.607E+00	5.580E+00	2.237E+00	1.012E+00	5.979E-01	9.965E-01

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 5.000E+01 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Co-57	9.877E-22	0.000E+00	0.000E+00	9.772E-21	3.817E-23
Co-60	2.706E-04	0.000E+00	0.000E+00	2.677E-03	1.046E-05
Cs-134	3.200E-08	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	2.009E-01	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	2.622E-06	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	1.020E-01	0.000E+00	0.000E+00	2.335E+00	9.121E-03
Sr-90	9.656E-03	0.000E+00	0.000E+00	3.983E-01	1.556E-03

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 5.000E+01 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Co-57	9.766E-21	3.563E-21	1.494E-20	2.201E-20	2.121E-20	2.098E-20	3.847E-21	1.140E-20	7.602E-21
Co-60	2.676E-03	9.762E-04	4.093E-03	5.770E-03	5.798E-03	5.747E-03	1.054E-03	3.124E-03	2.083E-03
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	2.335E+00	8.490E-01	3.570E+00	5.068E+00	5.056E+00	1.271E+00	9.198E+00	9.128E-01	9.128E-01
Sr-90	3.984E-01	1.615E-01	6.172E-01	8.767E-01	8.725E-01	3.498E-01	1.582E-01	9.349E-02	1.558E-01

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 1.000E+02 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Co-57	9.753E-43	0.000E+00	0.000E+00	1.907E-41	7.427E-44
Co-60	7.323E-08	0.000E+00	0.000E+00	1.431E-06	5.592E-09
Cs-134	1.024E-15	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	4.034E-02	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	6.873E-12	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	1.040E-02	0.000E+00	0.000E+00	2.384E-01	9.312E-04
Sr-90	9.323E-05	0.000E+00	0.000E+00	3.851E-03	1.504E-05

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters,
i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+02 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Co-57	1.907E-41	7.006E-42	2.943E-41	4.344E-41	4.064E-41	4.064E-41	8.408E-42	2.230E-41	1.486E-41
Co-60	1.432E-06	5.275E-07	2.192E-06	3.131E-06	3.105E-06	3.119E-06	5.644E-07	1.679E-06	1.119E-06
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Fe-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	2.384E-01	8.668E-02	3.644E-01	5.174E-01	5.161E-01	1.298E-01	9.390E-01	9.319E-02	9.319E-02
Sr-90	3.852E-03	1.561E-03	5.967E-03	8.476E-03	8.435E-03	3.382E-03	1.529E-03	9.038E-04	1.506E-03

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters,
i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 3.000E+02 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Co-57	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	3.927E-22	0.000E+00	0.000E+00	7.715E-21	3.014E-23
Cs-134	1.401E-45	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	6.566E-05	0.000E+00	0.000E+00	3.530E-04	1.379E-06
Fe-55	3.247E-34	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	1.124E-06	0.000E+00	0.000E+00	2.589E-05	1.011E-07
Sr-90	8.104E-13	0.000E+00	0.000E+00	3.364E-11	1.314E-13

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 3.000E+02 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Co-57	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	7.715E-21	9.831E-21	1.879E-20	2.392E-20	2.371E-20	2.060E-20	3.925E-21	9.046E-21	6.031E-21
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	3.530E-04	7.114E-04	1.123E-03	1.350E-03	1.348E-03	1.626E-03	8.512E-04	2.758E-03	1.379E-04
Fe-55	0.000E+00	7.215E-35	7.216E-35	7.316E-35	7.221E-35	3.910E-35	1.369E-36	0.000E+00	0.000E+00
Ni-63	2.590E-05	2.192E-05	5.207E-05	6.871E-05	6.855E-05	1.579E-05	1.178E-04	1.012E-05	1.012E-05
Sr-90	3.365E-11	6.780E-11	1.062E-10	1.283E-10	1.277E-10	4.130E-11	2.020E-11	7.896E-12	1.316E-11

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 5.000E+02 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Co-57	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	2.106E-36	0.000E+00	0.000E+00	4.158E-35	1.624E-37
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	1.069E-07	0.000E+00	0.000E+00	5.774E-07	2.255E-09
Fe-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	1.214E-10	0.000E+00	0.000E+00	2.813E-09	1.099E-11
Sr-90	7.044E-21	0.000E+00	0.000E+00	2.939E-19	1.148E-21

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 5.000E+02 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Co-57	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	4.158E-35	9.027E-35	1.385E-34	1.665E-34	1.651E-34	1.312E-34	2.586E-35	4.875E-35	3.250E-35
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	5.774E-07	2.109E-06	2.782E-06	3.155E-06	3.150E-06	3.428E-06	1.871E-06	4.512E-06	2.256E-07
Fe-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	2.813E-09	3.725E-09	6.999E-09	8.809E-09	8.788E-09	1.898E-09	1.449E-08	1.100E-09	1.100E-09
Sr-90	2.940E-19	1.061E-18	1.395E-18	1.591E-18	1.583E-18	4.625E-19	2.355E-19	6.898E-20	1.150E-19

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in environmental media
at t = 1.000E+03 years

Radio-Nuclide	Contaminated Zone pCi/g	Surface Soil* pCi/g	Air Particulate pCi/m**3	Well Water pCi/l	Surface Water pCi/l
Co-57	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	1.142E-14	1.142E-14	3.891E-21	6.249E-14	2.441E-16
Fe-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	1.475E-20	1.475E-20	5.023E-27	3.459E-19	1.351E-21
Sr-90	4.961E-41	4.961E-41	0.000E+00	0.000E+00	0.000E+00

*The Surface Soil is the top layer of soil within the user specified mixing zone/depth.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

Concentration of radionuclides in foodstuff media
at t = 1.000E+03 years*

Radio-Nuclide	Drinking Water pCi/l	Nonleafy Vegetable pCi/kg	Leafy Vegetable pCi/kg	Fodder Meat pCi/kg	Fodder Milk pCi/kg	Meat pCi/kg	Milk pCi/l	Fish pCi/kg	Crustacea pCi/kg
Co-57	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Co-60	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-134	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Cs-137	6.249E-14	4.796E-13	5.524E-13	5.932E-13	5.922E-13	7.468E-13	3.753E-13	4.883E-13	2.441E-14
Fe-55	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Ni-63	3.459E-19	8.641E-19	1.266E-18	1.490E-18	1.486E-18	3.254E-19	2.443E-18	1.352E-19	1.352E-19
Sr-90	0.000E+00	1.492E-38	1.489E-38	1.496E-38	1.489E-38	3.439E-39	1.932E-39	0.000E+00	0.000E+00

*Concentrations are at consumption time and include radioactive decay and ingrowth during storage time.
For livestock fodder, consumption time is t minus meat or milk storage time.

Concentrations in the media occurring in pathways that are suppressed are calculated using the current input parameters, i.e. using parameters appearing in the input screen when the pathways are active.

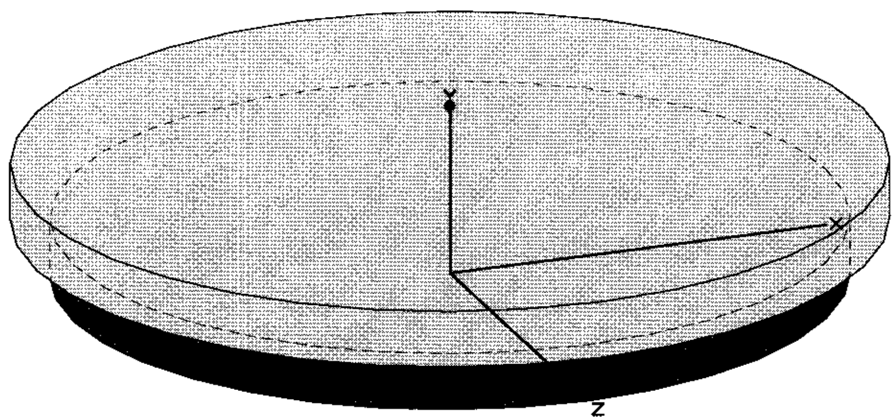
Attachment 6-12
Buried Piping/Conduit Microshield Output

MicroShield v5.01 (5.01-00010)
Maine Yankee Atomic Power

Page : 1
DOS File: Case1
Run Date: May 10, 2001
Run Time: 2:04:22 PM
Duration: 00:00:01

File Ref: 017-01
Date: 5-10-01
By: RPD
Checked:
(Illustration of Geometry)

Case Title: Co-60
Description: Case 1
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	100.0 cm	3 ft 3.4 in
Radius	671.84 cm	22 ft 0.5 in

Dose Points

	X	Y	Z
# 1	0 cm	300 cm	0 cm
	0.0 in	9 ft 10.1 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.42e+08 cm³	soil (SiO2)	1.6
Shield 1	100.0 cm	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Co-60	2.2688e-004	8.3947e+006	1.6000e-006	5.9200e-002

Buildup
The material reference is : Shield 1

Integration Parameters

Radial	20
Circumferential	10
Y Direction (axial)	10

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	1.369e+03	1.126e-11	6.382e-10	2.173e-14	1.232e-12

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: Case1
Case Title: Co-60
This case was run on Tuesday, March 20, 2001 at 4:36:54 PM
Dose Point # 1 - (0,300,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	7.087e-006	1.378e-004
Photon Energy Fluence Rate	MeV/cm²/sec	9.071e-006	1.753e-004
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.588e-008	3.074e-007
Absorbed Dose Rate in Air	mGy/hr	1.386e-010	2.683e-009
"	mrad/hr	1.386e-008	2.683e-007
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.573e-010	3.046e-009
o Opposed	"	1.356e-010	2.624e-009
o Rotational	"	1.356e-010	2.624e-009
o Isotropic	"	1.212e-010	2.345e-009
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.674e-010	3.242e-009
o Opposed	"	1.613e-010	3.122e-009
o Rotational	"	1.613e-010	3.122e-009
o Isotropic	"	1.284e-010	2.484e-009
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.417e-010	2.743e-009
o Posterior/Anterior	"	1.306e-010	2.527e-009
o Lateral	"	1.040e-010	2.011e-009
o Rotational	"	1.176e-010	2.276e-009
o Isotropic	"	1.042e-010	2.015e-009

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: Case1
Case Title: Co-57
This case was run on Tuesday, March 20, 2001 at 4:36:08 PM
Dose Point # 1 - (0,300,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.628e-010	9.016e-009
Photon Energy Fluence Rate	MeV/cm²/sec	1.117e-010	6.114e-009
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.157e-013	1.181e-011
Absorbed Dose Rate in Air	mGy/hr	1.883e-015	1.031e-013
"	mrad/hr	1.883e-013	1.031e-011
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.223e-015	1.218e-013
o Opposed	"	1.788e-015	9.789e-014
o Rotational	"	1.788e-015	9.789e-014
o Isotropic	"	1.581e-015	8.655e-014
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.366e-015	1.296e-013
o Opposed	"	2.250e-015	1.232e-013
o Rotational	"	2.250e-015	1.232e-013
o Isotropic	"	1.691e-015	9.256e-014
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.968e-015	1.078e-013
o Posterior/Anterior	"	1.742e-015	9.540e-014
o Lateral	"	1.298e-015	7.102e-014
o Rotational	"	1.557e-015	8.527e-014
o Isotropic	"	1.328e-015	7.271e-014

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: Case1
Case Title: Cs-134
This case was run on Tuesday, March 20, 2001 at 4:39:02 PM
Dose Point # 1 - (0,300,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	4.865e-007	1.673e-005
Photon Energy Fluence Rate	MeV/cm²/sec	4.898e-007	1.472e-005
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	8.871e-010	2.726e-008
Absorbed Dose Rate in Air	mGy/hr	7.744e-012	2.380e-010
"	mrad/hr	7.744e-010	2.380e-008
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	8.905e-012	2.759e-010
o Opposed	"	7.502e-012	2.291e-010
o Rotational	"	7.502e-012	2.291e-010
o Isotropic	"	6.675e-012	2.033e-010
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	9.488e-012	2.941e-010
o Opposed	"	9.101e-012	2.813e-010
o Rotational	"	9.101e-012	2.813e-010
o Isotropic	"	7.096e-012	2.167e-010
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	7.976e-012	2.463e-010
o Posterior/Anterior	"	7.253e-012	2.221e-010
o Lateral	"	5.650e-012	1.705e-010
o Rotational	"	6.515e-012	1.991e-010
o Isotropic	"	5.695e-012	1.726e-010

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: Case1
Case Title: Cs-137
This case was run on Tuesday, March 20, 2001 at 4:39:57 PM
Dose Point # 1 - (0,300,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.654e-008	3.882e-006
Photon Energy Fluence Rate	MeV/cm²/sec	4.403e-008	2.569e-006
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	8.535e-011	4.980e-009
Absorbed Dose Rate in Air	mGy/hr	7.451e-013	4.347e-011
"	mrad/hr	7.451e-011	4.347e-009
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	8.822e-013	5.147e-011
o Opposed	"	7.063e-013	4.121e-011
o Rotational	"	7.063e-013	4.121e-011
o Isotropic	"	6.246e-013	3.644e-011
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	9.376e-013	5.470e-011
o Opposed	"	8.906e-013	5.196e-011
o Rotational	"	8.906e-013	5.196e-011
o Isotropic	"	6.677e-013	3.895e-011
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	7.801e-013	4.551e-011
o Posterior/Anterior	"	6.885e-013	4.017e-011
o Lateral	"	5.106e-013	2.979e-011
o Rotational	"	6.153e-013	3.590e-011
o Isotropic	"	5.238e-013	3.056e-011

Attachment 6-13
DCGL/Total Dose Spreadsheets

Contaminated Material DCGL

Basement Contaminated Concrete (gross beta dpm/100 cm^2): Note: Annulus Trench Concrete DCGL = 9,500	18,000
Basement Activated Concrete (pCi/g):	1.0
Surface Soil (Cs-137 pCi/g):	3.0
Deep Soil (Cs-137 pCi/g):	3.0
Embedded Piping, (gross beta dpm/100 cm^2):	18,000
Ground Water (H-3, pCi/L):	6812
Surface Water (H-3, pCi/L):	960
Buried Piping, Conduit and Cable, (gross beta dpm/100 cm^2):	9,800

Contaminated Material Annual Dose

Material	Drinking Water (mrem/y)	Direct, Inhalation & Ingestion (mrem/y)	Total nnual Dose (mrem/y)
Contaminated Concrete	5.00E-01	5.63E-02	5.56E-01
Activated Concrete	1.42E-02	3.21E-02	4.63E-02
Surface Soil	0.00E+00	7.05E+00	7.05E+00
Deep Soil	1.22E-01	1.95E+00	2.07E+00
Embedded Piping	2.05E-02	2.34E-04	2.08E-02
Ground Water	2.08E-01	0.00E+00	2.08E-01
Surface Water	2.94E-02	1.27E-03	3.06E-02
Buried Piping, Conduit & Cab	4.56E-03	1.83E-03	6.40E-03
Total	**0.90 mrem/y 0**	**9.09 mrem/y 0**	**9.99 mrem/y 0**

CONTAMINATED CONCRETE

Key Parameters:

Porosity	0.30		Concrete Density	2.20	g/cm^3
Bulk Density	1.50	g/cm^3	Annual Total Well Water Vol	738.0	m^3
Yearly Drinking Water	478.0	L/yr	Irrigation Rate	0.274	L/m^2-d
Wall Surface Area	4182.0	m^2	Surface Soil Depth	0.15	m
Fill Volume	2460.0	m^3	Gross Beta DCGL	1.80E+04	dpm/100 cm^2
Surface Area/Open Volume	1.70	m^2/m^3	Gross Beta Nuclide Fraction	0.6160	
Concrete Volume	4.18	m^3	Total Inventory	2.92E+04	dpm/100 cm^2

	DOSE CALCULATION FACTORS			SOURCE TERM			Kd		WATER, FILL, CONCRETE CONCENTRATION			
Nuclide	NUREG-1727 mrem/y per pCi/g	FGR 11 mrem/pCi	Microshield mrem/y per pCi/g	Nuclide Fraction	Inventory dpm/100 cm^2	Inventory pCi	Kd Fill cm^3/gm	Kd Concrete cm^3/gm	Adsorption Factor	Water pCi/L	Fill pCi/g	Concrete pCi/g
Sr-90	1.47E+01	1.42E-04	0.00E+00	2.80E-03	8.19E+01	1.54E+07	6.00E+00	1.00E+00	3.10E+01	6.74E-01	4.04E-03	6.74E-04
Cs-134	4.39E+00	7.33E-05	6.09E-05	4.55E-03	1.33E+02	2.50E+07	5.60E+01	3.00E+00	2.81E+02	1.21E-01	6.76E-03	3.62E-04
Cs-137	2.27E+00	5.00E-05	1.20E-05	5.50E-01	1.61E+04	3.03E+09	5.60E+01	3.00E+00	2.81E+02	1.46E+01	8.18E-01	4.38E-02
Co-60	6.58E+00	2.69E-05	6.30E-04	5.84E-02	1.71E+03	3.22E+08	1.30E+01	1.00E+02	6.71E+01	6.48E+00	8.42E-02	6.48E-01
Co-57	1.67E-01	1.18E-06	2.80E-08	3.06E-04	8.95E+00	1.69E+06	1.30E+01	1.00E+02	6.71E+01	3.40E-02	4.42E-04	3.40E-03
Fe-55	2.50E-03	6.07E-07	0.00E+00	4.81E-03	1.41E+02	2.65E+07	2.50E+01	1.00E+02	1.27E+02	2.82E-01	7.05E-03	2.82E-02
H-3	2.27E-01	6.40E-08	0.00E+00	2.36E-02	6.88E+02	1.30E+08	0.00E+00	0.00E+00	1.00E+00	1.75E+02	0.00E+00	0.00E+00
Ni-63	1.19E-02	5.77E-07	0.00E+00	3.55E-01	1.04E+04	1.96E+09	1.20E+01	1.00E+02	6.21E+01	4.26E+01	5.11E-01	4.26E+00

CONTAMINATED CONCRETE ANNUAL DOSE				
Nuclide	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Sr-90	4.57E-02	4.40E-03	0.00E+00	5.01E-02
Cs-134	4.23E-03	2.36E-04	4.12E-07	4.46E-03
Cs-137	3.49E-01	1.47E-02	9.81E-06	3.64E-01
Co-60	8.33E-02	1.90E-02	5.31E-05	1.02E-01
Co-57	1.92E-05	2.52E-06	1.24E-11	2.17E-05
Fe-55	8.19E-05	3.14E-07	0.00E+00	8.22E-05
H-3	5.36E-03	1.77E-02	0.00E+00	2.31E-02
Ni-63	1.17E-02	2.25E-04	0.00E+00	1.20E-02
SUM	5.00E-01	5.62E-02	6.33E-05	5.56E-01

ACTIVATED CONCRETE

Key Parameters:

Porosity	0.30		Concrete Density	2.20	g/cm^3
Bulk Density	1.50	g/cm^3	Annual Total Well Water Vol	738.0	m^3
Yearly Drinking Water	478.0	L/yr	Irrigation Rate	0.274	L/m^2-d
Wall Surface Area	4182.0	m^2	Surface Soil Depth	0.15	m
Fill Volume	2460.0	m^3	Activated Concrete Total Inventory	3.43E+08	Total pCi per pCi/g
Surface Area/Open Volume	1.70	m^2/m^3	Activated Concrete Total Conc.	1.00	pCi/g
Concrete Volume	4.18	m^3			

DOSE CALCULATION FACTORS				SOURCE TERM			Kd		WATER, FILL, CONCRETE CONCENTRATION				ACTIVATED CONCRETE ANNUAL DOSE				
Nuclide	NUREG-1727 mrem/y per pCi/g	FGR 11 mrem/pCi	Microshield mrem/y per pCi/g	Nuclide Fraction	Inventory pCi/g	Inventory pCi	Kd Fill cm^3/gm	Kd Concrete cm^3/gm	Adsorption Factor	Water pCi/L	Fill pCi/g	Concrete pCi/g	Nuclide	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Cs-134	4.39E+00	7.33E-05	6.09E-05	4.00E-03	4.00E-03	1.37E+06	5.60E+01	3.00E+00	2.81E+02	6.62E-03	3.70E-04	1.98E-05	Cs-134	2.32E-04	1.29E-05	2.26E-08	2.45E-04
Co-60	6.58E+00	2.69E-05	6.30E-04	4.00E-02	4.00E-02	1.37E+07	1.30E+01	1.00E+02	6.71E+01	2.76E-01	3.59E-03	2.76E-02	Co-60	3.55E-03	8.09E-04	2.26E-06	4.37E-03
C-14	2.08E+00	2.09E-06	0.00E+00	5.80E-02	5.80E-02	1.99E+07	5.00E+00	1.00E+02	2.72E+01	9.89E-01	4.95E-03	9.89E-02	C-14	9.88E-04	9.15E-04	0.00E+00	1.90E-03
Eu-154	3.13E+00	9.55E-06	3.10E-04	9.00E-03	9.00E-03	3.09E+06	4.00E+02	0.00E+00	2.00E+03	2.09E-03	8.36E-04	0.00E+00	Eu-154	9.54E-06	2.90E-06	2.59E-07	1.27E-05
Fe-55	2.50E-03	6.07E-07	0.00E+00	1.24E-01	1.24E-01	4.25E+07	2.50E+01	1.00E+02	1.27E+02	4.53E-01	1.13E-02	4.53E-02	Fe-55	1.31E-04	5.03E-07	0.00E+00	1.32E-04
H-3	2.27E-01	6.40E-08	0.00E+00	6.47E-01	6.47E-01	2.22E+08	0.00E+00	0.00E+00	1.00E+00	3.00E+02	0.00E+00	0.00E+00	H-3	9.18E-03	3.03E-02	0.00E+00	3.95E-02
Eu-152	2.87E+00	6.48E-06	2.09E-04	1.11E-01	1.11E-01	3.81E+07	4.00E+02	0.00E+00	2.00E+03	2.58E-02	1.03E-02	0.00E+00	Eu-152	7.99E-05	3.29E-05	2.16E-06	1.15E-04
Ni-63	1.19E-02	5.77E-07	0.00E+00	7.00E-03	7.00E-03	2.40E+06	1.20E+01	1.00E+02	6.21E+01	5.23E-02	6.27E-04	5.23E-03	Ni-63	1.44E-05	2.76E-07	0.00E+00	1.47E-05
													SUM	1.42E-02	3.21E-02	4.70E-06	4.63E-02

SURFACE SOIL

Key Parameters:

Soil Depth	0.15	m
Surface Soil (Cs-137) Concentration	3.00	pCi/g
Surface Soil Total Concentration	3.37	pCi/g

DOSE CALCULATION FACTORS		SOURCE TERM		SURFACE SOIL ANNUAL DOSE
Nuclide	**NUREG-1727 mrem/y per pCi/g**	**Nuclide Fraction**	**Soil pCi/g**	**Total Dose mrem/y**
Cs-137	2.27E+00	8.90E-01	3.00E+00	6.81E+00
Co-60	6.58E+00	9.00E-03	3.03E-02	2.00E-01
H-3	2.27E-01	5.30E-02	1.79E-01	4.06E-02
Ni-63	1.19E-02	4.80E-02	1.62E-01	1.93E-03
				SUM 7.05E+00

3/17/01

DEEP SOIL

Key Parameters:

Porosity	0.3		Surface Soil Depth	0.15	m
Bulk Density	1.6	g/cm^3	Deep Soil (Cs-137) Concentration	3.00	pCi/g
Yearly Drinking Water	478	L/y	Deep Soil Total Concentration	3.37	pCi/g
Irrigation Rate	0.274	L/m^2-d			

DOSE CALCULATION FACTORS				SOURCE TERM			DEEP SOIL ANNUAL DOSE			
Nuclide	NUREG-1727 mrem/y per pCi/g	FGR 11 mrem/pCi	Microshield mrem/y per pCi/g	Nuclide Fraction	Deep Soil Inventory pCi/g	Water Inventory pCi/L per pCi/g	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Cs-137	2.27E+00	5.00E-05	4.00E-01	8.90E-01	3.00E+00	1.10E+00	7.89E-02	1.04E-03	1.20E+00	1.28E+00
Co-60	6.58E+00	2.69E-05	2.40E+00	9.00E-03	3.03E-02	6.60E-01	2.57E-04	1.81E-03	7.28E-02	7.49E-02
H-3	2.27E-01	6.40E-08	0.00E+00	5.30E-02	1.79E-01	7.10E+03	3.88E-02	6.72E-01	0.00E+00	7.10E-01
Ni-63	1.19E-02	5.77E-07	0.00E+00	4.80E-02	1.62E-01	9.40E+01	4.19E-03	4.66E-04	0.00E+00	4.66E-03
							1.22E-01	6.75E-01	1.27E+00	2.07E+00

EMBEDDED PIPE

Key Parameters:

Porosity	0.30		Concrete Density	2.20	g/cm^3
Bulk Density	1.50	g/cm^3	Surface Soil Depth	0.15	m
Yearly Drinking Water	478.0	l/yr	Irrigation Rate	0.274	L/m^2-d
Wall Surface Area	4182.0	m^2	Annual Total Well Water Vol	738	m^3
Fill Volume	2460.0	m^3	Embedded Pipe Conversion Factor	7748.0	pCi per dpm/100 cm^2
Surface Area/Open Volume	1.70	m^2/m^3	Gross Beta DCGL	1.80E+04	dpm/100 cm^2
Concrete Volume	4.18	m^3	Gross Beta Nuclide Fraction	0.616	
			Total Inventory	2.92E+04	dpm/100 cm^2

DOSE CALCULATION FACTORS				SOURCE TERM			Kd		WATER, FILL, CONCRETE CONCENTRATION				EMBEDDED PIPE ANNUAL DOSE				
Nuclide	NUREG-1727 mrem/y per pCi/g	FGR 11 mrem/pCi	Microshield mrem/y per pCi/g	Fraction	Inventory dpm/100 cm^2	Inventory pCi	Kd Fill cm^3/gm	Kd Concrete cm^3/gm	Adsorption Factor	Water pCi/L	Fill pCi/g	Concrete pCi/g	Nuclide	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Sr-90	1.47E+01	1.42E-04	0.00E+00	2.80E-03	8.19E+01	6.34E+05	6.00E+00	1.00E+00	3.10E+01	2.77E-02	1.66E-04	2.77E-05	Sr-90	1.88E-03	1.81E-05	0.00E+00	1.90E-03
Cs-134	4.39E+00	7.33E-05	6.09E-05	4.55E-03	1.33E+02	1.03E+06	5.60E+01	3.00E+00	2.81E+02	4.96E-03	2.78E-04	1.49E-05	Cs-134	1.74E-04	9.69E-07	1.69E-08	1.75E-04
Cs-137	2.27E+00	5.00E-05	1.20E-05	5.50E-01	1.61E+04	1.25E+08	5.60E+01	3.00E+00	2.81E+02	6.01E-01	3.36E-02	1.80E-03	Cs-137	1.44E-02	6.06E-05	4.04E-07	1.44E-02
Co-60	6.58E+00	2.69E-05	6.30E-04	5.84E-02	1.71E+03	1.32E+07	1.30E+01	1.00E+02	6.71E+01	2.67E-01	3.46E-03	2.67E-02	Co-60	3.43E-03	7.79E-05	2.18E-06	3.51E-03
Co-57	1.67E-01	1.18E-06	2.80E-08	3.06E-04	8.95E+00	6.94E+04	1.30E+01	1.00E+02	6.71E+01	1.40E-03	1.82E-05	1.40E-04	Co-57	7.89E-07	1.04E-08	5.09E-13	7.99E-07
Fe-55	2.50E-03	6.07E-07	0.00E+00	4.81E-03	1.41E+02	1.09E+06	2.50E+01	1.00E+02	1.27E+02	1.16E-02	2.90E-04	1.16E-03	Fe-55	3.37E-06	1.29E-09	0.00E+00	3.37E-06
H-3	2.27E-01	6.40E-08	0.00E+00	2.36E-02	6.88E+02	5.33E+06	0.00E+00	0.00E+00	1.00E+00	7.21E+00	0.00E+00	0.00E+00	H-3	2.21E-04	7.28E-05	0.00E+00	2.93E-04
Ni-63	1.19E-02	5.77E-07	0.00E+00	3.55E-01	1.04E+04	8.04E+07	1.20E+01	1.00E+02	6.21E+01	1.75E+00	2.10E-02	1.75E-01	Ni-63	4.83E-04	9.26E-07	0.00E+00	4.84E-04
													SUM	2.05E-02	2.31E-04	2.60E-06	2.08E-02

GROUND WATER

Key Parameters:

Annual Water Intake 478 L/y

Dose Calculation Factors		Source Term		Ground Water Annual Dose
Nuclide	**FGR 11 mrem/pCi**	**Nuclide Fraction**	**Inventory pCi/L**	**Drinking Water Dose mrem/y**
H-3	6.40E-08	1.00E+00	6,812	2.08E-01
				SUM 2.08E-01

3/18/01

SURFACE WATER

Key Parameters:

Annual Water Intake	478	L/y
Annual Fish Consumption	20.6	Kg/y

Calculation factors			Source Term		Surface Water Annual Dose		
Nuclide	**FGR 11 mrem/pCi**	**Bioaccumulation Factor for Fish pCi/Kg per pCi/L**	**Nuclide Fraction**	**Water Inventory pCi/L**	**Drinking Water Dose mrem/y**	**Fish Ingestion Dose mrem/y**	**Total Dose mrem/y**
H-3	6.40E-08	1.00E+00	1.00E+00	960	2.94E-02	1.27E-03	3.06E-02
				SUM	2.94E-02	1.27E-03	3.06E-02

BURIED PIPE and CONDUIT

Key Parameters:

Porosity	0.3	
Bulk Density	1.6	g/cm^3
Yearly Drinking Water	478	L/y
Irrigation Rate	0.274	L/m^2-d
Surface Soil Depth	0.15	m

Buried Pipe Conversion Factor	2.59E-04	pCi/g per dpm/100 cm^2
Gross Beta DCGL	9.80E+03	dpm/100 cm^2
Gross Beta Nuclide Fraction	0.616	
Total Inventory	1.59E+04	dpm/100 cm^2

Dose Calculation Factors				Source Term				Buried Piping and Conduit Annual Dose			
Nuclide	FGR 11 mrem/pCi	NUREG-1727 mrem/y per pCi/g	Microshield mrem/y per pCi/g	Nuclide Fraction	Water Inventory pCi/L per pCi/g	Pipe Surface Inventory dpm/100cm^2	Soil Inventory pCi/g	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Sr-90	1.42E-04	1.47E+01	0.00E+00	2.80E-03	3.69E+00	4.46E+01	1.15E-02	2.89E-03	2.61E-04	0.00E+00	3.15E-03
Cs-134	7.33E-05	4.39E+00	2.21E-05	4.55E-03	0.00E+00	7.23E+01	1.87E-02	0.00E+00	0.00E+00	4.14E-07	4.14E-07
Cs-137	5.00E-05	2.27E+00	3.97E-06	5.50E-01	1.02E-03	8.75E+03	2.27E+00	5.53E-05	2.19E-06	9.01E-06	6.65E-05
Co-60	2.69E-05	6.58E+00	2.53E-04	5.84E-02	2.96E-03	9.29E+02	2.41E-01	9.16E-06	1.95E-06	6.09E-05	7.20E-05
Co-57	1.18E-06	1.67E-01	9.44E-09	3.06E-04	3.39E-20	4.88E+00	1.26E-03	2.41E-26	2.98E-27	1.19E-11	1.19E-11
Fe-55	6.07E-07	2.50E-03	0.00E+00	4.81E-03	0.00E+00	7.66E+01	1.98E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00
H-3	6.40E-08	2.27E-01	0.00E+00	2.36E-02	1.61E+02	3.75E+02	9.70E-02	4.78E-04	1.48E-03	0.00E+00	1.96E-03
Ni-63	5.77E-07	1.19E-02	0.00E+00	3.55E-01	2.80E+00	5.65E+03	1.46E+00	1.13E-03	2.03E-05	0.00E+00	1.15E-03
								4.56E-03	1.76E-03	7.03E-05	6.40E-03

CONTAMINATED CONCRETE ANNULUS TRENCH DOSE

Key Parameters:

Porosity	0.30		Concrete Density	2.20	g/cm^3		
Bulk Density	1.50	g/cm^3	Annual Total Well Water Vol	738.0	m^3		
Yearly Drinking Water	478.0	L/yr	Irrigation Rate	0.274	L/m^2-d		
Wall Surface Area	4182.0	m^2	Surface Soil Depth	0.15	m	**5.56E-01**	**<== Total Dose Contaminated Concrete**
Fill Volume	2460.0	m^3	**Trench Gross Beta DCGL**	**9.50E+03**	dpm/100 cm^2		
Surface Area/Open Volume	1.70	m^2/m^3	Gross Beta Nuclide Fraction	0.9388		**4.51E-01**	**<== Total Dose Trench**
Concrete Volume	4.18	m^3	Total Inventory	1.01E+04	dpm/100 cm^2		

	DOSE CALCULATION FACTORS			SOURCE TERM			Kd		WATER, FILL, CONCRETE CONCENTRATION			
Nuclide	NUREG-1727 mrem/y per pCi/g	FGR 11 mrem/pCi	Microshield mrem/y per pCi/g	Nuclide Fraction	Inventory dpm/100 cm^2	Inventory pCi	Kd Fill cm^3/gm	Kd Concrete cm^3/gm	Adsorption Factor	Water pCi/L	Fill pCi/g	Concrete pCi/g
Sr-90	1.47E+01	1.42E-04	0.00E+00	3.51E-03	3.56E+01	6.70E+06	6.00E+00	1.00E+00	3.10E+01	2.93E-01	1.76E-03	2.93E-04
Sb-125	9.77E-01	2.81E-06	3.83E-06	3.15E-03	3.18E+01	6.00E+06	4.50E+01	0.00E+00	2.26E+02	3.60E-02	1.62E-03	0.00E+00
Cs-134	4.39E+00	7.33E-05	6.09E-05	1.77E-03	1.79E+01	3.38E+06	5.60E+01	3.00E+00	2.81E+02	1.63E-02	9.13E-04	4.89E-05
Cs-137	2.27E+00	5.00E-05	1.20E-05	3.66E-01	3.71E+03	6.98E+08	5.60E+01	3.00E+00	2.81E+02	3.37E+00	1.89E-01	1.01E-02
Pu-238	1.00E+01	3.20E-03	2.45E-25	3.88E-05	3.93E-01	7.40E+04	5.50E+02	5.00E+03	2.81E+03	3.56E-05	1.96E-05	1.78E-04
Pu-239	1.09E+01	3.54E-03	6.10E-15	2.07E-05	2.10E-01	3.95E+04	5.50E+02	5.00E+03	2.81E+03	1.90E-05	1.05E-05	9.52E-05
Pu-240	1.09E+01	3.54E-03	7.52E-26	2.07E-05	2.10E-01	3.95E+04	5.50E+02	5.00E+03	2.81E+03	1.90E-05	1.05E-05	9.51E-05
Pu-241	3.47E-01	6.85E-05	0.00E+00	1.56E-03	1.58E+01	2.98E+06	5.50E+02	5.00E+03	2.81E+03	1.43E-03	7.89E-04	7.17E-03
Am-241	1.19E+01	3.64E-03	1.65E-19	9.98E-06	1.01E-01	1.90E+04	1.90E+03	5.00E+03	9.55E+03	2.70E-06	5.12E-06	1.35E-05
Cm-243	7.81E+00	2.51E-03	1.27E-08	7.45E-07	7.54E-03	1.42E+03	4.00E+03	5.00E+03	2.00E+04	9.60E-08	3.84E-07	4.80E-07
Cm-244	6.00E+00	2.02E-03	9.81E-25	7.15E-07	7.23E-03	1.36E+03	4.00E+03	5.00E+03	2.00E+04	9.20E-08	3.68E-07	4.60E-07
Co-60	6.58E+00	2.69E-05	6.30E-04	5.64E-01	5.71E+03	1.08E+09	1.30E+01	1.00E+02	6.71E+01	2.17E+01	2.82E-01	2.17E+00
Co-57	1.67E-01	1.18E-06	2.80E-08	4.80E-04	4.85E+00	9.14E+05	1.30E+01	1.00E+02	6.71E+01	1.84E-02	2.39E-04	1.84E-03
Mn-54	1.67E+00	2.77E-06	4.40E-05	4.32E-04	4.38E+00	8.24E+05	5.00E+01	0.00E+00	2.51E+02	4.45E-03	2.22E-04	0.00E+00
Fe-55	2.50E-03	6.07E-07	0.00E+00	1.89E-03	1.92E+01	3.61E+06	2.50E+01	1.00E+02	1.27E+02	3.84E-02	9.61E-04	3.84E-03
H-3	2.27E-01	6.40E-08	0.00E+00	5.04E-03	5.10E+01	9.60E+06	0.00E+00	0.00E+00	1.00E+00	1.30E+01	0.00E+00	0.00E+00
Ni-63	1.19E-02	5.77E-07	0.00E+00	5.17E-02	5.23E+02	9.85E+07	1.20E+01	1.00E+02	6.21E+01	2.14E+00	2.57E-02	2.14E-01

CONTAMINATED CONCRETE ANNUAL DOSE				
Nuclide	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Sr-90	1.99E-02	1.91E-03	0.00E+00	2.18E-02
Sb-125	4.83E-05	1.56E-05	6.20E-09	6.39E-05
Cs-134	5.71E-04	3.18E-05	5.56E-08	6.03E-04
Cs-137	8.05E-02	3.40E-03	2.26E-06	8.39E-02
Pu-238	5.45E-05	1.58E-07	4.80E-30	5.47E-05
Pu-239	3.22E-05	9.22E-08	6.39E-20	3.23E-05
Pu-240	3.22E-05	9.22E-08	7.87E-31	3.23E-05
Pu-241	4.70E-05	2.21E-07	0.00E+00	4.72E-05
Am-241	4.69E-06	1.43E-08	8.47E-25	4.71E-06
Cm-243	1.15E-07	3.33E-10	4.87E-15	1.15E-07
Cm-244	8.88E-08	2.45E-10	3.61E-31	8.91E-08
Co-60	2.79E-01	6.34E-02	1.77E-04	3.42E-01
Co-57	1.04E-05	1.37E-06	6.70E-12	1.18E-05
Mn-54	5.89E-06	3.30E-06	9.79E-09	9.20E-06
Fe-55	1.12E-05	4.27E-08	0.00E+00	1.12E-05
H-3	3.97E-04	1.31E-03	0.00E+00	1.71E-03
Ni-63	5.92E-04	1.13E-05	0.00E+00	6.03E-04
SUM	3.81E-01	7.00E-02	1.80E-04	4.51E-01

Attachment 6-14
Soil Area Factor Microshield Output

MicroShield v5.01 (5.01-00010)
Maine Yankee Atomic Power

Page : 1
DOS File : S10000.MS5
Run Date: March 24, 2001
Run Time: 2:48:51 PM
Duration : 00:00:15

Case Title: Soil AF 10,000 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	15.0 cm	5.9 in
Width	1.0e+4 cm	328 ft 1.0 in
Height	1.0e+4 cm	328 ft 1.0 in

Dose Points

	X	Y	Z
# 1	115 cm	5000 cm	5000 cm
	3 ft 9.3 in	164 ft 0.5 in	164 ft 0.5 in

Shields

Shield Name	Dimension	Material	Density
Source	1500.0 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.1360e-003	7.9032e+007	1.4240e-006	5.2688e-002
Co-60	2.1600e-005	7.9920e+005	1.4400e-008	5.3280e-004
Cs-137	2.1360e-003	7.9032e+007	1.4240e-006	5.2688e-002
H-3	1.2720e-004	4.7064e+006	8.4800e-008	3.1376e-003
Ni-63	1.1520e-004	4.2624e+006	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Pa

X Direction
Y Direction
Z Direction

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	8.204e+05	4.186e-08	4.583e-08	2.869e-08	3.141e-08
0.0318	1.636e+06	1.427e-05	2.112e-05	1.189e-07	1.759e-07
0.0322	3.019e+06	2.750e-05	4.103e-05	2.213e-07	3.302e-07
0.0364	1.099e+06	1.535e-05	2.543e-05	8.719e-08	1.445e-07
0.6616	7.111e+07	1.258e-01	2.740e-01	2.439e-04	5.311e-04
0.6938	1.304e+02	2.464e-07	5.279e-07	4.758e-10	1.019e-09
1.1732	7.992e+05	3.160e-03	5.745e-03	5.647e-06	1.027e-05
1.3325	7.992e+05	3.781e-03	6.633e-03	6.559e-06	1.151e-05
TOTALS:	7.929e+07	1.328e-01	2.864e-01	2.566e-04	5.536e-04

Page : 1
DOS File : S5000.MS5
Run Date: March 24, 2001
Run Time: 2:50:31 PM
Duration : 00:00:15

Case Title: Soil AF 5,000 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	15.0 cm	5.9 in
Width	7.1e+3 cm	231 ft 11.9 in
Height	7.1e+3 cm	231 ft 11.9 in

Dose Points

	X	Y	Z
# 1	115 cm	3535.5 cm	3535.5 cm
	3 ft 9.3 in	115 ft 11.9 in	115 ft 11.9 in

Shields

Shield Name	Dimension	Material	Density
Source	750.007 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 8
Lower Energy Cutoff : 0
Photons < 0 : Excluded
Library : Grove

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	1.0680e-003	3.9516e+007	1.4240e-006	5.2688e-002
Co-60	1.0800e-005	3.9960e+005	1.4400e-008	5.3280e-004
Cs-137	1.0680e-003	3.9516e+007	1.4240e-006	5.2688e-002
H-3	6.3601e-005	2.3532e+006	8.4800e-008	3.1376e-003
Ni-63	5.7601e-005	2.1312e+006	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

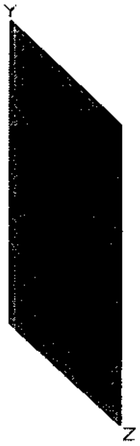
Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	4.102e+05	3.956e-08	4.309e-08	2.711e-08	2.954e-08
0.0318	8.181e+05	1.350e-05	2.001e-05	1.125e-07	1.667e-07
0.0322	1.509e+06	2.601e-05	3.888e-05	2.093e-07	3.129e-07
0.0364	5.493e+05	1.453e-05	2.413e-05	8.253e-08	1.371e-07
0.6616	3.556e+07	1.183e-01	2.593e-01	2.292e-04	5.027e-04
0.6938	6.518e+01	2.317e-07	4.998e-07	4.473e-10	9.650e-10

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
1.1732	3.996e+05	2.977e-03	5.460e-03	5.321e-06	9.757e-06
1.3325	3.996e+05	3.565e-03	6.308e-03	6.185e-06	1.094e-05
TOTALS:	3.964e+07	1.248e-01	2.712e-01	2.412e-04	5.240e-04

Page : 1
DOS File : S2500.MS5
Run Date: March 24, 2001
Run Time: 2:51:53 PM
Duration : 00:00:14

Case Title: Soil AF 2,500 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	5.0e+3 cm	164 ft 0.5 in
Height	5.0e+3 cm	164 ft 0.5 in

Dose Points

	X	Y	Z
# 1	115 cm	2500 cm	2500 cm
	3 ft 9.3 in	82 ft 0.3 in	82 ft 0.3 in

Shields

Shield Name	Dimension	Material	Density
Source	375.0 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	5.3400e-004	1.9758e+007	1.4240e-006	5.2688e-002
Co-60	5.4000e-006	1.9980e+005	1.4400e-008	5.3280e-004
Cs-137	5.3400e-004	1.9758e+007	1.4240e-006	5.2688e-002
H-3	3.1800e-005	1.1766e+006	8.4800e-008	3.1376e-003
Ni-63	2.8800e-005	1.0656e+006	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

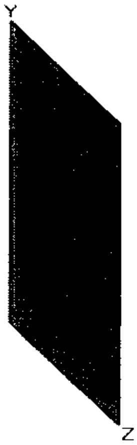
Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	2.051e+05	3.401e-08	3.707e-08	2.331e-08	2.541e-08
0.0318	4.090e+05	1.282e-05	1.908e-05	1.067e-07	1.589e-07
0.0322	7.547e+05	2.469e-05	3.708e-05	1.987e-07	2.984e-07
0.0364	2.746e+05	1.381e-05	2.298e-05	7.845e-08	1.306e-07
0.6616	1.778e+07	1.132e-01	2.508e-01	2.194e-04	4.863e-04
0.6938	3.259e+01	2.218e-07	4.835e-07	4.282e-10	9.336e-10
1.1732	1.998e+05	2.860e-03	5.287e-03	5.111e-06	9.448e-06
1.3325	1.998e+05	3.427e-03	6.110e-03	5.946e-06	1.060e-05
TOTALS:	1.982e+07	1.195e-01	2.623e-01	2.309e-04	5.069e-04

MicroShield v5.01 (5.01-00010)
Maine Yankee Atomic Power

Page : 1
DOS File : S2000.MS5
Run Date: March 24, 2001
Run Time: 2:53:23 PM
Duration : 00:00:14

Case Title: Soil AF 2,000 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	4.5e+3 cm	146 ft 8.7 in
Height	4.5e+3 cm	146 ft 8.7 in

Dose Points

	X	Y	Z
# 1	115 cm	2236.1 cm	2236.1 cm
	3 ft 9.3 in	73 ft 4.4 in	73 ft 4.4 in

Shields

Shield Name	Dimension	Material	Density
Source	299.995 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 8
Lower Energy Cutoff : 0
Photons < 0 : Excluded
Library : Grove

Nuclide	curies	becquerels	µCi/cm³	Bq/cm³
Ba-137m	4.2719e-004	1.5806e+007	1.4240e-006	5.2688e-002
Co-60	4.3199e-006	1.5984e+005	1.4400e-008	5.3280e-004
Cs-137	4.2719e-004	1.5806e+007	1.4240e-006	5.2688e-002
H-3	2.5440e-005	9.4126e+005	8.4800e-008	3.1376e-003
Ni-63	2.3040e-005	8.5247e+005	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	1.641e+05	3.288e-08	3.588e-08	2.254e-08	2.459e-08
0.0318	3.272e+05	1.271e-05	1.892e-05	1.058e-07	1.576e-07
0.0322	6.037e+05	2.448e-05	3.676e-05	1.970e-07	2.958e-07
0.0364	2.197e+05	1.369e-05	2.278e-05	7.779e-08	1.294e-07
0.6616	1.422e+07	1.123e-01	2.492e-01	2.177e-04	4.831e-04
0.6938	2.607e+01	2.201e-07	4.804e-07	4.249e-10	9.275e-10

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
1.1732	1.598e+05	2.839e-03	5.251e-03	5.074e-06	9.384e-06
1.3325	1.598e+05	3.403e-03	6.068e-03	5.904e-06	1.053e-05
TOTALS:	1.586e+07	1.186e-01	2.606e-01	2.291e-04	5.037e-04

Page : 1
DOS File : S1000.MS5
Run Date: March 24, 2001
Run Time: 2:55:05 PM
Duration : 00:00:14

Case Title: Soil AF 1,000 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	15.0 cm	5.9 in
Width	3.2e+3 cm	103 ft 9.0 in
Height	3.2e+3 cm	103 ft 9.0 in

Dose Points

	X	Y	Z
# 1	115 cm	1581.1 cm	1581.1 cm
	3 ft 9.3 in	51 ft 10.5 in	51 ft 10.5 in

Shields

Shield Name	Dimension	Material	Density
Source	150.002 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.1360e-004	7.9033e+006	1.4240e-006	5.2688e-002
Co-60	2.1600e-006	7.9921e+004	1.4400e-008	5.3280e-004
Cs-137	2.1360e-004	7.9033e+006	1.4240e-006	5.2688e-002
H-3	1.2720e-005	4.7065e+005	8.4800e-008	3.1376e-003
Ni-63	1.1520e-005	4.2625e+005	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

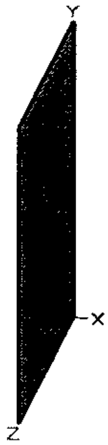
X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	8.204e+04	3.185e-08	3.482e-08	2.183e-08	2.387e-08
0.0318	1.636e+05	1.261e-05	1.876e-05	1.051e-07	1.563e-07
0.0322	3.019e+05	2.430e-05	3.644e-05	1.956e-07	2.933e-07
0.0364	1.099e+05	1.357e-05	2.255e-05	7.712e-08	1.281e-07
0.6616	7.111e+06	1.105e-01	2.447e-01	2.143e-04	4.743e-04
0.6938	1.304e+01	2.166e-07	4.716e-07	4.182e-10	9.105e-10
1.1732	7.992e+04	2.792e-03	5.147e-03	4.990e-06	9.199e-06
1.3325	7.992e+04	3.345e-03	5.946e-03	5.804e-06	1.032e-05
TOTALS:	7.929e+06	1.167e-01	2.558e-01	2.255e-04	4.944e-04

Page : 1
DOS File : S500.MS5
Run Date: March 24, 2001
Run Time: 2:57:20 PM
Duration : 00:00:14

Case Title: Soil AF 500 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	2.2e+3 cm	73 ft 4.4 in
Height	2.2e+3 cm	73 ft 4.4 in

Dose Points

	X	Y	Z
# 1	115 cm	1118 cm	1118 cm
	3 ft 9.3 in	36 ft 8.2 in	36 ft 8.2 in

Shields

Shield Name	Dimension	Material	Density
Source	75.002 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 8
Lower Energy Cutoff : 0
Photons < 0 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	1.0680e-004	3.9517e+006	1.4240e-006	5.2688e-002
Co-60	1.0800e-006	3.9961e+004	1.4400e-008	5.3280e-004
Cs-137	1.0680e-004	3.9517e+006	1.4240e-006	5.2688e-002
H-3	6.3602e-006	2.3533e+005	8.4800e-008	3.1376e-003
Ni-63	5.7602e-006	2.1313e+005	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	4.102e+04	3.222e-08	3.523e-08	2.209e-08	2.415e-08
0.0318	8.181e+04	1.259e-05	1.868e-05	1.048e-07	1.556e-07
0.0322	1.509e+05	2.424e-05	3.627e-05	1.951e-07	2.919e-07
0.0364	5.493e+04	1.348e-05	2.229e-05	7.660e-08	1.267e-07
0.6616	3.556e+06	1.082e-01	2.381e-01	2.097e-04	4.615e-04
0.6938	6.518e+00	2.120e-07	4.588e-07	4.093e-10	8.858e-10

DOS File : S500.MS5
Run Date: March 24, 2001
Run Time: 2:57:20 PM
Duration : 00:00:14

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
1.1732	3.996e+04	2.727e-03	4.998e-03	4.873e-06	8.932e-06
1.3325	3.996e+04	3.265e-03	5.769e-03	5.665e-06	1.001e-05
TOTALS:	3.964e+06	1.142e-01	2.489e-01	2.207e-04	4.811e-04

Page : 1
DOS File : S300.MS5
Run Date: March 24, 2001
Run Time: 2:58:56 PM
Duration : 00:00:14

Case Title: Soil AF 300 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	15.0 cm	5.9 in
Width	1.7e+3 cm	56 ft 9.9 in
Height	1.7e+3 cm	56 ft 9.9 in

Dose Points

	X	Y	Z
# 1	115 cm	866 cm	866 cm
	3 ft 9.3 in	28 ft 4.9 in	28 ft 4.9 in

Shields

Shield Name	Dimension	Material	Density
Source	45.003 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	6.4084e-005	2.3711e+006	1.4240e-006	5.2688e-002
Co-60	6.4804e-007	2.3977e+004	1.4400e-008	5.3280e-004
Cs-137	6.4084e-005	2.3711e+006	1.4240e-006	5.2688e-002
H-3	3.8162e-006	1.4120e+005	8.4800e-008	3.1376e-003
Ni-63	3.4562e-006	1.2788e+005	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	2.461e+04	3.233e-08	3.533e-08	2.216e-08	2.422e-08
0.0318	4.909e+04	1.246e-05	1.843e-05	1.038e-07	1.535e-07
0.0322	9.057e+04	2.399e-05	3.576e-05	1.930e-07	2.878e-07
0.0364	3.296e+04	1.329e-05	2.186e-05	7.549e-08	1.242e-07
0.6616	2.134e+06	1.055e-01	2.311e-01	2.046e-04	4.479e-04
0.6938	3.911e+00	2.067e-07	4.452e-07	3.991e-10	8.596e-10
1.1732	2.398e+04	2.655e-03	4.840e-03	4.744e-06	8.648e-06
1.3325	2.398e+04	3.177e-03	5.583e-03	5.512e-06	9.686e-06
TOTALS:	2.379e+06	1.114e-01	2.416e-01	2.152e-04	4.669e-04

Page : 1
DOS File : S100.MS5
Run Date: March 24, 2001
Run Time: 3:00:17 PM
Duration : 00:00:14

Case Title: Soil AF 100 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	15.0 cm	5.9 in
Width	1.0e+3 cm	32 ft 9.7 in
Height	1.0e+3 cm	32 ft 9.7 in

Dose Points

	X	Y	Z
# 1	115 cm	500 cm	500 cm
	3 ft 9.3 in	16 ft 4.9 in	16 ft 4.9 in

Shields

Shield Name	Dimension	Material	Density
Source	15.0 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 8
Lower Energy Cutoff : 0
Photons < 0 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.1360e-005	7.9032e+005	1.4240e-006	5.2688e-002
Co-60	2.1600e-007	7.9920e+003	1.4400e-008	5.3280e-004
Cs-137	2.1360e-005	7.9032e+005	1.4240e-006	5.2688e-002
H-3	1.2720e-006	4.7064e+004	8.4800e-008	3.1376e-003
Ni-63	1.1520e-006	4.2624e+004	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	8.204e+03	3.231e-08	3.532e-08	2.215e-08	2.421e-08
0.0318	1.636e+04	1.173e-05	1.717e-05	9.774e-08	1.431e-07
0.0322	3.019e+04	2.256e-05	3.328e-05	1.816e-07	2.678e-07
0.0364	1.099e+04	1.240e-05	2.016e-05	7.043e-08	1.146e-07
0.6616	7.111e+05	9.655e-02	2.080e-01	1.872e-04	4.032e-04
0.6938	1.304e+00	1.891e-07	4.005e-07	3.650e-10	7.732e-10

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
1.1732	7.992e+03	2.414e-03	4.320e-03	4.314e-06	7.720e-06
1.3325	7.992e+03	2.884e-03	4.972e-03	5.004e-06	8.626e-06
TOTALS:	7.929e+05	1.019e-01	2.173e-01	1.969e-04	4.201e-04

Page : 1
DOS File : S50.MS5
Run Date: March 24, 2001
Run Time: 3:01:48 PM
Duration : 00:00:14

Case Title: Soil AF 50 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	15.0 cm	5.9 in
Width	707.1 cm	23 ft 2.4 in
Height	707.1 cm	23 ft 2.4 in

Dose Points

	X	Y	Z
# 1	115 cm	353.6 cm	353.6 cm
	3 ft 9.3 in	11 ft 7.2 in	11 ft 7.2 in

Shields

Shield Name	Dimension	Material	Density
Source	7.5 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	1.0680e-005	3.9515e+005	1.4240e-006	5.2688e-002
Co-60	1.0800e-007	3.9959e+003	1.4400e-008	5.3280e-004
Cs-137	1.0680e-005	3.9515e+005	1.4240e-006	5.2688e-002
H-3	6.3599e-007	2.3532e+004	8.4800e-008	3.1376e-003
Ni-63	5.7599e-007	2.1312e+004	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	4.102e+03	3.228e-08	3.528e-08	2.212e-08	2.418e-08
0.0318	8.181e+03	1.086e-05	1.580e-05	9.049e-08	1.316e-07
0.0322	1.509e+04	2.088e-05	3.060e-05	1.680e-07	2.463e-07
0.0364	5.493e+03	1.143e-05	1.851e-05	6.497e-08	1.052e-07
0.6616	3.556e+05	8.783e-02	1.858e-01	1.703e-04	3.602e-04
0.6938	6.518e-01	1.719e-07	3.576e-07	3.319e-10	6.904e-10
1.1732	3.996e+03	2.182e-03	3.826e-03	3.899e-06	6.838e-06
1.3325	3.996e+03	2.602e-03	4.394e-03	4.514e-06	7.624e-06
TOTALS:	3.964e+05	9.266e-02	1.941e-01	1.790e-04	3.752e-04

Page : 1
DOS File : S25.MS5
Run Date: March 24, 2001
Run Time: 3:02:54 PM
Duration : 00:00:13

Case Title: Soil AF 25 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	15.0 cm	5.9 in
Width	500.0 cm	16 ft 4.9 in
Height	500.0 cm	16 ft 4.9 in

Dose Points

	X	Y	Z
# 1	115 cm	250 cm	250 cm
	3 ft 9.3 in	8 ft 2.4 in	8 ft 2.4 in

Shields

Shield Name	Dimension	Material	Density
Source	3.75 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 8
Lower Energy Cutoff : 0
Photons < 0 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	5.3400e-006	1.9758e+005	1.4240e-006	5.2688e-002
Co-60	5.4000e-008	1.9980e+003	1.4400e-008	5.3280e-004
Cs-137	5.3400e-006	1.9758e+005	1.4240e-006	5.2688e-002
H-3	3.1800e-007	1.1766e+004	8.4800e-008	3.1376e-003
Ni-63	2.8800e-007	1.0656e+004	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

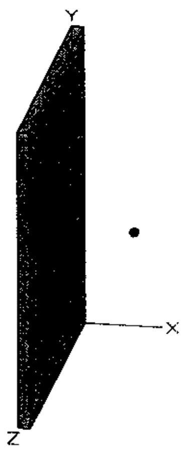
Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	2.051e+03	3.198e-08	3.494e-08	2.192e-08	2.395e-08
0.0318	4.090e+03	9.616e-06	1.391e-05	8.010e-08	1.159e-07
0.0322	7.547e+03	1.848e-05	2.695e-05	1.487e-07	2.169e-07
0.0364	2.746e+03	1.010e-05	1.630e-05	5.739e-08	9.261e-08
0.6616	1.778e+05	7.613e-02	1.568e-01	1.476e-04	3.040e-04
0.6938	3.259e-01	1.489e-07	3.015e-07	2.875e-10	5.821e-10

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
1.1732	1.998e+03	1.874e-03	3.196e-03	3.348e-06	5.710e-06
1.3325	1.998e+03	2.229e-03	3.660e-03	3.866e-06	6.350e-06
TOTALS:	1.982e+05	8.027e-02	1.637e-01	1.551e-04	3.165e-04

Page : 1
DOS File : S16.MS5
Run Date: March 24, 2001
Run Time: 3:04:16 PM
Duration : 00:00:13

Case Title: Soil AF 16 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	400.0 cm	13 ft 1.5 in
Height	400.0 cm	13 ft 1.5 in

Dose Points

	X	Y	Z
# 1	115 cm	200 cm	200 cm
	3 ft 9.3 in	6 ft 6.7 in	6 ft 6.7 in

Shields

Shield Name	Dimension	Material	Density
Source	2.4 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	3.4176e-006	1.2645e+005	1.4240e-006	5.2688e-002
Co-60	3.4560e-008	1.2787e+003	1.4400e-008	5.3280e-004
Cs-137	3.4176e-006	1.2645e+005	1.4240e-006	5.2688e-002
H-3	2.0352e-007	7.5302e+003	8.4800e-008	3.1376e-003
Ni-63	1.8432e-007	6.8198e+003	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

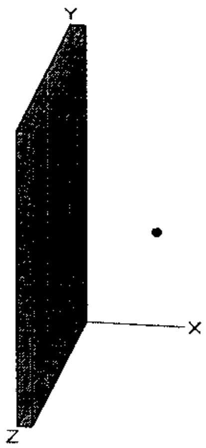
X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	1.313e+03	3.129e-08	3.417e-08	2.145e-08	2.342e-08
0.0318	2.618e+03	8.613e-06	1.243e-05	7.175e-08	1.035e-07
0.0322	4.830e+03	1.655e-05	2.408e-05	1.332e-07	1.938e-07
0.0364	1.758e+03	9.038e-06	1.455e-05	5.135e-08	8.269e-08
0.6616	1.138e+05	6.703e-02	1.351e-01	1.299e-04	2.619e-04
0.6938	2.086e-01	1.311e-07	2.596e-07	2.530e-10	5.013e-10
1.1732	1.279e+03	1.638e-03	2.735e-03	2.926e-06	4.887e-06
1.3325	1.279e+03	1.944e-03	3.127e-03	3.373e-06	5.425e-06
TOTALS:	1.269e+05	7.064e-02	1.410e-01	1.365e-04	2.726e-04

Page : 1
DOS File : S10.MS5
Run Date: March 24, 2001
Run Time: 3:05:30 PM
Duration : 00:00:13

Case Title: Soil AF 10 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	316.2 cm	10 ft 4.5 in
Height	316.2 cm	10 ft 4.5 in

Dose Points

	X	Y	Z
# 1	115 cm	158.1 cm	158.1 cm
	3 ft 9.3 in	5 ft 2.2 in	5 ft 2.2 in

Shields

Shield Name	Dimension	Material	Density
Source	1.5 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 8
Lower Energy Cutoff : 0
Photons < 0 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.1356e-006	7.9018e+004	1.4240e-006	5.2688e-002
Co-60	2.1596e-008	7.9906e+002	1.4400e-008	5.3280e-004
Cs-137	2.1356e-006	7.9018e+004	1.4240e-006	5.2688e-002
H-3	1.2718e-007	4.7056e+003	8.4800e-008	3.1376e-003
Ni-63	1.1518e-007	4.2617e+003	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

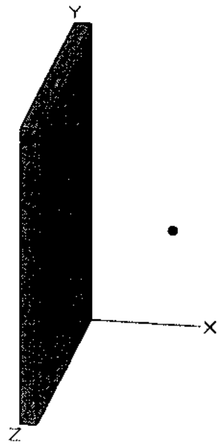
Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	8.203e+02	2.971e-08	3.241e-08	2.036e-08	2.221e-08
0.0318	1.636e+03	7.413e-06	1.067e-05	6.175e-08	8.885e-08
0.0322	3.018e+03	1.424e-05	2.066e-05	1.146e-07	1.663e-07
0.0364	1.098e+03	7.770e-06	1.248e-05	4.415e-08	7.093e-08
0.6616	7.110e+04	5.646e-02	1.110e-01	1.095e-04	2.151e-04
0.6938	1.303e-01	1.103e-07	2.132e-07	2.130e-10	4.116e-10

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
1.1732	7.991e+02	1.368e-03	2.232e-03	2.444e-06	3.989e-06
1.3325	7.991e+02	1.620e-03	2.549e-03	2.811e-06	4.422e-06
TOTALS:	7.927e+04	5.948e-02	1.158e-01	1.149e-04	2.239e-04

Page : 1
DOS File : S8.MS5
Run Date: March 24, 2001
Run Time: 3:06:55 PM
Duration : 00:00:13

Case Title: Soil AF 8 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	282.8 cm	9 ft 3.3 in
Height	282.8 cm	9 ft 3.3 in

Dose Points

	X	Y	Z
# 1	115 cm	141.4 cm	141.4 cm
	3 ft 9.3 in	4 ft 7.7 in	4 ft 7.7 in

Shields

Shield Name	Dimension	Material	Density
Source	1.2 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	1.7083e-006	6.3207e+004	1.4240e-006	5.2688e-002
Co-60	1.7275e-008	6.3917e+002	1.4400e-008	5.3280e-004
Cs-137	1.7083e-006	6.3207e+004	1.4240e-006	5.2688e-002
H-3	1.0173e-007	3.7640e+003	8.4800e-008	3.1376e-003
Ni-63	9.2132e-008	3.4089e+003	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

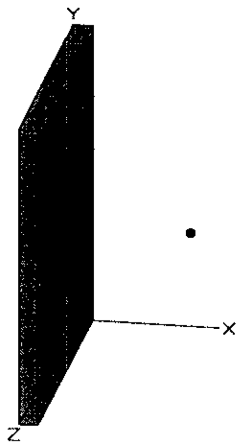
X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	6.561e+02	2.855e-08	3.112e-08	1.957e-08	2.133e-08
0.0318	1.309e+03	6.806e-06	9.780e-06	5.669e-08	8.146e-08
0.0322	2.414e+03	1.307e-05	1.894e-05	1.052e-07	1.524e-07
0.0364	8.786e+02	7.131e-06	1.145e-05	4.051e-08	6.503e-08
0.6616	5.687e+04	5.126e-02	9.954e-02	9.937e-05	1.930e-04
0.6938	1.043e-01	1.001e-07	1.912e-07	1.933e-10	3.691e-10
1.1732	6.392e+02	1.237e-03	1.997e-03	2.210e-06	3.568e-06
1.3325	6.392e+02	1.464e-03	2.278e-03	2.540e-06	3.953e-06
TOTALS:	6.341e+04	5.399e-02	1.039e-01	1.043e-04	2.008e-04

Page : 1
DOS File : S6.MS5
Run Date: March 24, 2001
Run Time: 3:08:16 PM
Duration : 00:00:13

Case Title: Soil AF 6 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	244.9 cm	8 ft 0.4 in
Height	244.9 cm	8 ft 0.4 in

Dose Points

	X	Y	Z
# 1	115 cm	122.5 cm	122.5 cm
	3 ft 9.3 in	4 ft 0.2 in	4 ft 0.2 in

Shields

Shield Name	Dimension	Material	Density
Source	.9 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 8
Lower Energy Cutoff : 0
Photons < 0 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	1.2811e-006	4.7400e+004	1.4240e-006	5.2688e-002
Co-60	1.2955e-008	4.7933e+002	1.4400e-008	5.3280e-004
Cs-137	1.2811e-006	4.7400e+004	1.4240e-006	5.2688e-002
H-3	7.6289e-008	2.8227e+003	8.4800e-008	3.1376e-003
Ni-63	6.9092e-008	2.5564e+003	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

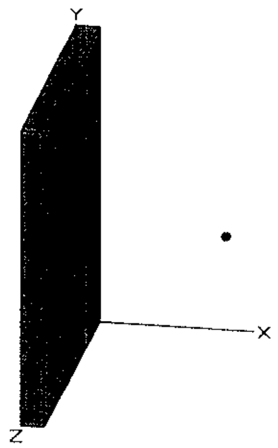
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	4.921e+02	2.666e-08	2.903e-08	1.827e-08	1.990e-08
0.0318	9.813e+02	6.008e-06	8.618e-06	5.005e-08	7.179e-08
0.0322	1.811e+03	1.154e-05	1.669e-05	9.288e-08	1.343e-07
0.0364	6.589e+02	6.290e-06	1.009e-05	3.574e-08	5.730e-08
0.6616	4.265e+04	4.457e-02	8.523e-02	8.640e-05	1.652e-04
0.6938	7.819e-02	8.703e-08	1.636e-07	1.680e-10	3.159e-10

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
1.1732	4.793e+02	1.070e-03	1.704e-03	1.912e-06	3.046e-06
1.3325	4.793e+02	1.265e-03	1.944e-03	2.194e-06	3.372e-06
TOTALS:	4.755e+04	4.693e-02	8.891e-02	9.071e-05	1.719e-04

MicroShield v5.01 (5.01-00010)
Maine Yankee Atomic Power

Page : 1
DOS File : S4.MS5
Run Date: March 24, 2001
Run Time: 3:09:18 PM
Duration : 00:00:13

Case Title: Soil AF 4 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	200.0 cm	6 ft 6.7 in
Height	200.0 cm	6 ft 6.7 in

Dose Points

	X	Y	Z
# 1	115 cm	100 cm	100 cm
	3 ft 9.3 in	3 ft 3.4 in	3 ft 3.4 in

Shields

Shield Name	Dimension	Material	Density
Source	.6 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	8.5440e-007	3.1613e+004	1.4240e-006	5.2688e-002
Co-60	8.6400e-009	3.1968e+002	1.4400e-008	5.3280e-004
Cs-137	8.5440e-007	3.1613e+004	1.4240e-006	5.2688e-002
H-3	5.0880e-008	1.8826e+003	8.4800e-008	3.1376e-003
Ni-63	4.6080e-008	1.7050e+003	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

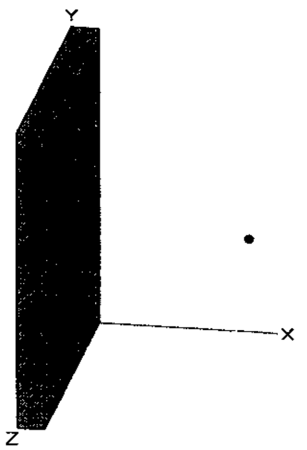
X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	3.282e+02	2.330e-08	2.532e-08	1.597e-08	1.736e-08
0.0318	6.545e+02	4.894e-06	7.006e-06	4.077e-08	5.836e-08
0.0322	1.208e+03	9.400e-06	1.357e-05	7.565e-08	1.092e-07
0.0364	4.394e+02	5.119e-06	8.195e-06	2.908e-08	4.656e-08
0.6616	2.845e+04	3.553e-02	6.658e-02	6.887e-05	1.291e-04
0.6938	5.215e-02	6.934e-08	1.278e-07	1.339e-10	2.467e-10
1.1732	3.197e+02	8.474e-04	1.327e-03	1.514e-06	2.371e-06
1.3325	3.197e+02	1.000e-03	1.512e-03	1.735e-06	2.623e-06
TOTALS:	3.171e+04	3.739e-02	6.944e-02	7.228e-05	1.343e-04

Page : 1
DOS File : S3.MS5
Run Date: March 24, 2001
Run Time: 3:11:03 PM
Duration : 00:00:13

Case Title: Soil AF 3 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	173.2 cm	5 ft 8.2 in
Height	173.2 cm	5 ft 8.2 in

Dose Points

	X	Y	Z
# 1	115 cm	86.6 cm	86.6 cm
	3 ft 9.3 in	2 ft 10.1 in	2 ft 10.1 in

Shields

Shield Name	Dimension	Material	Density
Source	.45 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 8
Lower Energy Cutoff : 0
Photons < 0 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	6.4076e-007	2.3708e+004	1.4240e-006	5.2688e-002
Co-60	6.4796e-009	2.3975e+002	1.4400e-008	5.3280e-004
Cs-137	6.4076e-007	2.3708e+004	1.4240e-006	5.2688e-002
H-3	3.8158e-008	1.4118e+003	8.4800e-008	3.1376e-003
Ni-63	3.4558e-008	1.2786e+003	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	2.461e+02	2.058e-08	2.234e-08	1.410e-08	1.531e-08
0.0318	4.908e+02	4.141e-06	5.921e-06	3.449e-08	4.932e-08
0.0322	9.056e+02	7.953e-06	1.147e-05	6.401e-08	9.230e-08
0.0364	3.295e+02	4.328e-06	6.922e-06	2.459e-08	3.933e-08
0.6616	2.133e+04	2.961e-02	5.479e-02	5.741e-05	1.062e-04
0.6938	3.911e-02	5.778e-08	1.051e-07	1.115e-10	2.030e-10

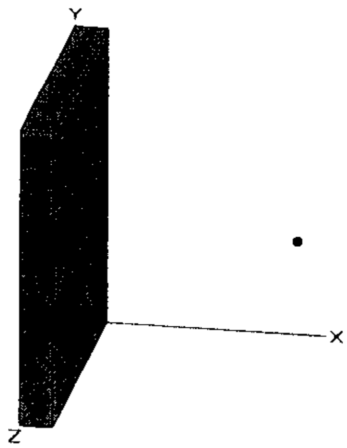
Page : 2
DOS File : S3.MS5
Run Date: March 24, 2001
Run Time: 3:11:03 PM
Duration : 00:00:13

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
1.1732	2.397e+02	7.034e-04	1.090e-03	1.257e-06	1.948e-06
1.3325	2.397e+02	8.293e-04	1.241e-03	1.439e-06	2.154e-06
TOTALS:	2.378e+04	3.116e-02	5.714e-02	6.024e-05	1.105e-04

MicroShield v5.01 (5.01-00010)
Maine Yankee Atomic Power

Page : 1
DOS File : S2.MS5
Run Date: March 24, 2001
Run Time: 3:12:24 PM
Duration : 00:00:13

Case Title: Soil AF 2 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	141.42 cm	4 ft 7.7 in
Height	141.42 cm	4 ft 7.7 in

Dose Points

	X	Y	Z
# 1	115 cm	70.71 cm	70.71 cm
	3 ft 9.3 in	2 ft 3.8 in	2 ft 3.8 in

Shields

Shield Name	Dimension	Material	Density
Source	.3 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	4.2719e-007	1.5806e+004	1.4240e-006	5.2688e-002
Co-60	4.3199e-009	1.5984e+002	1.4400e-008	5.3280e-004
Cs-137	4.2719e-007	1.5806e+004	1.4240e-006	5.2688e-002
H-3	2.5440e-008	9.4126e+002	8.4800e-008	3.1376e-003
Ni-63	2.3040e-008	8.5246e+002	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

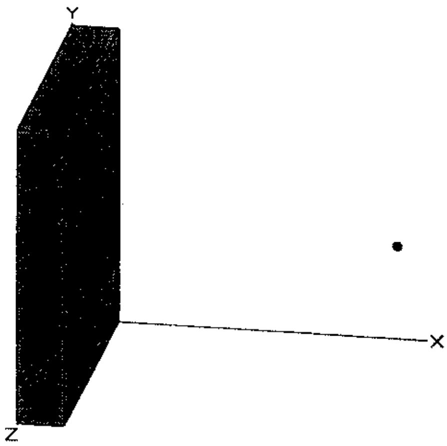
X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	1.641e+02	1.659e-08	1.798e-08	1.137e-08	1.233e-08
0.0318	3.272e+02	3.177e-06	4.537e-06	2.647e-08	3.780e-08
0.0322	6.037e+02	6.102e-06	8.788e-06	4.911e-08	7.073e-08
0.0364	2.197e+02	3.318e-06	5.300e-06	1.885e-08	3.011e-08
0.6616	1.422e+04	2.228e-02	4.059e-02	4.320e-05	7.869e-05
0.6938	2.607e-02	4.346e-08	7.788e-08	8.391e-11	1.504e-10
1.1732	1.598e+02	5.267e-04	8.059e-04	9.413e-07	1.440e-06
1.3325	1.598e+02	6.203e-04	9.173e-04	1.076e-06	1.592e-06
TOTALS:	1.586e+04	2.344e-02	4.233e-02	4.532e-05	8.188e-05

Page : 1
DOS File : S1.MS5
Run Date: March 24, 2001
Run Time: 3:13:19 PM
Duration : 00:00:13

Case Title: Soil AF 1 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	100.0 cm	3 ft 3.4 in
Height	100.0 cm	3 ft 3.4 in

Dose Points

	X	Y	Z
# 1	115 cm	50 cm	50 cm
	3 ft 9.3 in	1 ft 7.7 in	1 ft 7.7 in

Shields

Shield Name	Dimension	Material	Density
Source	.15 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 8
Lower Energy Cutoff : 0
Photons < 0 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.1360e-007	7.9032e+003	1.4240e-006	5.2688e-002
Co-60	2.1600e-009	7.9920e+001	1.4400e-008	5.3280e-004
Cs-137	2.1360e-007	7.9032e+003	1.4240e-006	5.2688e-002
H-3	1.2720e-008	4.7064e+002	8.4800e-008	3.1376e-003
Ni-63	1.1520e-008	4.2624e+002	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

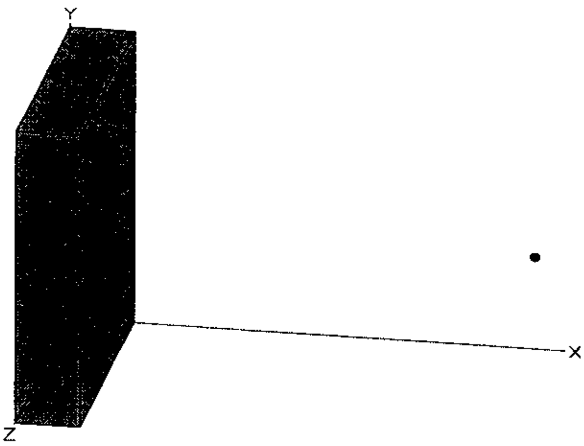
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	8.204e+01	1.042e-08	1.127e-08	7.145e-09	7.726e-09
0.0318	1.636e+02	1.881e-06	2.682e-06	1.567e-08	2.234e-08
0.0322	3.019e+02	3.612e-06	5.195e-06	2.907e-08	4.181e-08
0.0364	1.099e+02	1.962e-06	3.128e-06	1.115e-08	1.777e-08
0.6616	7.111e+03	1.285e-02	2.296e-02	2.491e-05	4.451e-05
0.6938	1.304e-02	2.505e-08	4.404e-08	4.836e-11	8.503e-11

Energy MeV	Activity photons/sec	Fluence Rate $MeV/cm^2/sec$ No Buildup	Fluence Rate $MeV/cm^2/sec$ With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
1.1732	7.992e+01	3.019e-04	4.547e-04	5.394e-07	8.125e-07
1.3325	7.992e+01	3.550e-04	5.173e-04	6.159e-07	8.975e-07
TOTALS:	7.929e+03	1.351e-02	2.394e-02	2.613e-05	4.631e-05

MicroShield v5.01 (5.01-00010)
Maine Yankee Atomic Power

Page : 1
DOS File : SO_5.MS5
Run Date: March 24, 2001
Run Time: 3:14:50 PM
Duration : 00:00:13

Case Title: Soil AF 0.5 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	15.0 cm	5.9 in
Width	70.71 cm	2 ft 3.8 in
Height	70.71 cm	2 ft 3.8 in

Dose Points

	X	Y	Z
# 1	115 cm	35.36 cm	35.36 cm
	3 ft 9.3 in	1 ft 1.9 in	1 ft 1.9 in

Shields

Shield Name	Dimension	Material	Density
Source	.075 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	1.0680e-007	3.9515e+003	1.4240e-006	5.2688e-002
Co-60	1.0800e-009	3.9959e+001	1.4400e-008	5.3280e-004
Cs-137	1.0680e-007	3.9515e+003	1.4240e-006	5.2688e-002
H-3	6.3599e-009	2.3532e+002	8.4800e-008	3.1376e-003
Ni-63	5.7599e-009	2.1312e+002	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	4.102e+01	5.960e-09	6.436e-09	4.085e-09	4.412e-09
0.0318	8.181e+01	1.039e-06	1.481e-06	8.657e-09	1.233e-08
0.0322	1.509e+02	1.995e-06	2.867e-06	1.606e-08	2.307e-08
0.0364	5.493e+01	1.083e-06	1.725e-06	6.153e-09	9.799e-09
0.6616	3.556e+03	6.975e-03	1.232e-02	1.352e-05	2.388e-05
0.6938	6.518e-03	1.359e-08	2.363e-08	2.624e-11	4.562e-11
1.1732	3.996e+01	1.633e-04	2.437e-04	2.918e-07	4.355e-07
1.3325	3.996e+01	1.918e-04	2.772e-04	3.328e-07	4.809e-07
TOTALS:	3.964e+03	7.334e-03	1.285e-02	1.418e-05	2.485e-05

MicroShield v5.01 (5.01-00010)
Maine Yankee Atomic Power

Page : 1
DOS File : S0_25.MS5
Run Date: March 24, 2001
Run Time: 3:15:49 PM
Duration : 00:00:13

Case Title: Soil AF 0.25 m^2
Description: Surface Soil
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	15.0 cm	5.9 in
Width	50.0 cm	1 ft 7.7 in
Height	50.0 cm	1 ft 7.7 in

Dose Points

	X	Y	Z
# 1	115 cm	25 cm	25 cm
	3 ft 9.3 in	9.8 in	9.8 in

Shields

Shield Name	Dimension	Material	Density
Source	.038 m³	soil (SiO2)	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 8
Lower Energy Cutoff : 0
Photons < 0 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	5.3400e-008	1.9758e+003	1.4240e-006	5.2688e-002
Co-60	5.4000e-010	1.9980e+001	1.4400e-008	5.3280e-004
Cs-137	5.3400e-008	1.9758e+003	1.4240e-006	5.2688e-002
H-3	3.1800e-009	1.1766e+002	8.4800e-008	3.1376e-003
Ni-63	2.8800e-009	1.0656e+002	7.6800e-008	2.8416e-003

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0045	2.051e+01	3.208e-09	3.462e-09	2.199e-09	2.373e-09
0.0318	4.090e+01	5.490e-07	7.818e-07	4.573e-09	6.512e-09
0.0322	7.547e+01	1.054e-06	1.514e-06	8.483e-09	1.218e-08
0.0364	2.746e+01	5.718e-07	9.100e-07	3.248e-09	5.170e-09
0.6616	1.778e+03	3.647e-03	6.400e-03	7.071e-06	1.241e-05
0.6938	3.259e-03	7.107e-09	1.228e-08	1.372e-11	2.370e-11

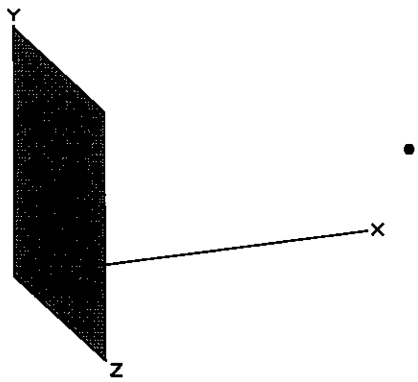
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
1.1732	1.998e+01	8.520e-05	1.265e-04	1.523e-07	2.261e-07
1.3325	1.998e+01	1.001e-04	1.439e-04	1.736e-07	2.496e-07
TOTALS:	1.982e+03	3.835e-03	6.674e-03	7.415e-06	1.291e-05

Attachment 6-15
Standing Building Area Factor Microshield Output

Page : 1
DOS File: CC_05.MS5
Run Date: May 1, 2001
Run Time: 4:39:49 PM
Duration: 00:00:05

File Ref:
Date: 5/1/01
By: RHO
Checked:

Case Title: AF 0.5 m^2
Description: Contaminated Concrete
Geometry: 4 - Rectangular Area - Vertical



Source Dimensions

Width	70.71 cm	2 ft 3.8 in
Height	70.71 cm	2 ft 3.8 in

Dose Points

	X	Y	Z
# 1	100 cm	35.36 cm	35.36 cm
	3 ft 3.4 in	1 ft 1.9 in	1 ft 1.9 in

Shields

Shield Name	Material	Density
Air Gap	Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 24
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm²	Bq/cm²
Ba-137m	1.2400e-011	4.5879e-001	2.4800e-009	9.1760e-005
Co-57	6.8999e-015	2.5530e-004	1.3800e-012	5.1060e-008
Co-60	1.3150e-012	4.8654e-002	2.6300e-010	9.7310e-006
Cs-134	1.0250e-013	3.7924e-003	2.0500e-011	7.5850e-007
Cs-137	1.2400e-011	4.5879e-001	2.4800e-009	9.1760e-005
Fe-55	1.0850e-013	4.0144e-003	2.1700e-011	8.0290e-007
H-3	5.2999e-013	1.9610e-002	1.0600e-010	3.9220e-006
Ni-63	7.9998e-012	2.9599e-001	1.6000e-009	5.9200e-005
Sr-90	6.2999e-014	2.3310e-003	1.2600e-011	4.6620e-007
Y-90	6.2999e-014	2.3310e-003	1.2600e-011	4.6620e-007

Buildup
The material reference is : Air Gap

Integration Parameters

Z Direction	20
Y Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	9.498e-03	2.142e-09	2.245e-09	1.785e-11	1.870e-11
0.0318	8.130e-06	1.834e-12	1.921e-12	1.528e-14	1.600e-14
0.0322	1.752e-02	4.002e-09	4.193e-09	3.221e-11	3.374e-11
0.0322	1.500e-05	3.426e-12	3.589e-12	2.757e-14	2.888e-14

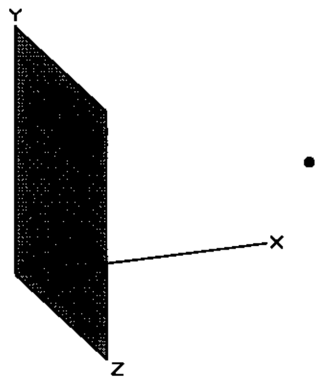
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0364	6.377e-03	1.655e-09	1.734e-09	9.403e-12	9.850e-12
0.0364	5.459e-06	1.417e-12	1.484e-12	8.049e-15	8.431e-15
0.1221	2.183e-04	1.927e-10	1.984e-10	3.021e-13	3.111e-13
0.1365	2.707e-05	2.673e-11	2.748e-11	4.298e-14	4.419e-14
0.2769	1.343e-06	2.699e-12	2.742e-12	5.063e-15	5.144e-15
0.4753	5.537e-05	1.916e-10	1.937e-10	3.760e-13	3.800e-13
0.536	7.318e-08	2.857e-13	2.885e-13	5.603e-16	5.659e-16
0.5632	3.178e-04	1.304e-09	1.317e-09	2.553e-12	2.578e-12
0.5693	5.852e-04	2.427e-09	2.450e-09	4.751e-12	4.796e-12
0.6047	3.701e-03	1.631e-08	1.646e-08	3.183e-11	3.211e-11
0.6616	4.128e-01	1.992e-06	2.008e-06	3.861e-09	3.893e-09
0.692	4.082e-07	2.060e-12	2.077e-12	3.978e-15	4.011e-15
0.6938	7.936e-06	4.016e-11	4.048e-11	7.753e-14	7.816e-14
0.7958	3.239e-03	1.881e-08	1.895e-08	3.580e-11	3.606e-11
0.8019	3.311e-04	1.937e-09	1.952e-09	3.684e-12	3.711e-12
1.0386	3.792e-05	2.877e-10	2.895e-10	5.268e-13	5.300e-13
1.1679	6.826e-05	5.826e-10	5.859e-10	1.042e-12	1.048e-12
1.1732	4.865e-02	4.172e-07	4.195e-07	7.455e-10	7.496e-10
1.3325	4.865e-02	4.740e-07	4.764e-07	8.224e-10	8.266e-10
1.3652	1.153e-04	1.151e-09	1.157e-09	1.985e-12	1.995e-12
TOTALS:	5.523e-01	2.934e-06	2.956e-06	5.571e-09	5.616e-09

Page : 1
DOS File: CC1.MS5
Run Date: May 1, 2001
Run Time: 4:38:22 PM
Duration: 00:00:05

Attachment 6-15
Page 4 of 19

File Ref:
Date: 5/1/01
By: RHG
Checked:

Case Title: AF 1 m^2
Description: Contaminated Concrete
Geometry: 4 - Rectangular Area - Vertical



Source Dimensions

Width	100.0 cm	3 ft 3.4 in
Height	100.0 cm	3 ft 3.4 in

Dose Points

	X	Y	Z
# 1	100 cm	50 cm	50 cm
	3 ft 3.4 in	1 ft 7.7 in	1 ft 7.7 in

Shields

Shield Name	Material	Density
Air Gap	Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm²	Bq/cm²
Ba-137m	2.4800e-011	9.1760e-001	2.4800e-009	9.1760e-005
Co-57	1.3800e-014	5.1060e-004	1.3800e-012	5.1060e-008
Co-60	2.6300e-012	9.7310e-002	2.6300e-010	9.7310e-006
Cs-134	2.0500e-013	7.5850e-003	2.0500e-011	7.5850e-007
Cs-137	2.4800e-011	9.1760e-001	2.4800e-009	9.1760e-005
Fe-55	2.1700e-013	8.0290e-003	2.1700e-011	8.0290e-007
H-3	1.0600e-012	3.9220e-002	1.0600e-010	3.9220e-006
Ni-63	1.6000e-011	5.9200e-001	1.6000e-009	5.9200e-005
Sr-90	1.2600e-013	4.6620e-003	1.2600e-011	4.6620e-007
Y-90	1.2600e-013	4.6620e-003	1.2600e-011	4.6620e-007

Buildup
The material reference is : Air Gap

Integration Parameters

Z Direction	20
Y Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	1.900e-02	3.996e-09	4.193e-09	3.329e-11	3.493e-11
0.0318	1.626e-05	3.421e-12	3.589e-12	2.849e-14	2.990e-14
0.0322	3.505e-02	7.465e-09	7.833e-09	6.008e-11	6.304e-11
0.0322	3.000e-05	6.390e-12	6.705e-12	5.142e-14	5.396e-14
0.0364	1.275e-02	3.088e-09	3.239e-09	1.754e-11	1.840e-11
0.0364	1.092e-05	2.643e-12	2.773e-12	1.502e-14	1.575e-14
0.1221	4.366e-04	3.596e-10	3.708e-10	5.639e-13	5.813e-13
0.1365	5.414e-05	4.989e-11	5.135e-11	8.022e-14	8.257e-14

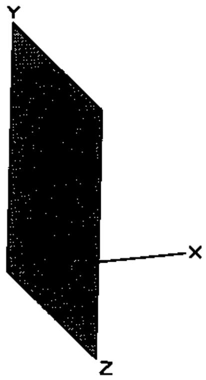
DOS File: CC1.MS5
Run Date: May 1, 2001
Run Time: 4:38:22 PM
Duration: 00:00:05

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.2769	2.685e-06	5.039e-12	5.122e-12	9.452e-15	9.608e-15
0.4753	1.107e-04	3.577e-10	3.617e-10	7.019e-13	7.098e-13
0.536	1.464e-07	5.334e-13	5.389e-13	1.046e-15	1.057e-15
0.5632	6.356e-04	2.435e-09	2.459e-09	4.767e-12	4.814e-12
0.5693	1.170e-03	4.532e-09	4.576e-09	8.869e-12	8.956e-12
0.6047	7.403e-03	3.046e-08	3.074e-08	5.942e-11	5.998e-11
0.6616	8.257e-01	3.718e-06	3.751e-06	7.208e-09	7.271e-09
0.692	8.164e-07	3.846e-12	3.879e-12	7.428e-15	7.490e-15
0.6938	1.587e-05	7.497e-11	7.561e-11	1.448e-13	1.460e-13
0.7958	6.478e-03	3.512e-08	3.538e-08	6.683e-11	6.734e-11
0.8019	6.622e-04	3.617e-09	3.645e-09	6.878e-12	6.930e-12
1.0386	7.585e-05	5.372e-10	5.406e-10	9.837e-13	9.898e-13
1.1679	1.365e-04	1.088e-09	1.094e-09	1.946e-12	1.957e-12
1.1732	9.731e-02	7.789e-07	7.834e-07	1.392e-09	1.400e-09
1.3325	9.731e-02	8.851e-07	8.897e-07	1.536e-09	1.544e-09
1.3652	2.306e-04	2.149e-09	2.160e-09	3.706e-12	3.725e-12
TOTALS:	1.105e+00	5.478e-06	5.521e-06	1.040e-08	1.049e-08

Page : 1
DOS File: CC2.MS5
Run Date: May 1, 2001
Run Time: 4:37:12 PM
Duration: 00:00:05

File Ref:
Date: 5/1/01
By: RTD
Checked:

Case Title: AF 2 m^2
Description: Contaminated Concrete
Geometry: 4 - Rectangular Area - Vertical



Source Dimensions

Width	141.4 cm	4 ft 7.7 in
Height	141.4 cm	4 ft 7.7 in

Dose Points

	X	Y	Z
# 1	100 cm	70.71 cm	70.71 cm
	3 ft 3.4 in	2 ft 3.8 in	2 ft 3.8 in

Shields

Shield Name	Material	Density
Air Gap	Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 24
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	µCi/cm²	Bq/cm²
Ba-137m	4.9585e-011	1.8346e+000	2.4800e-009	9.1760e-005
Co-57	2.7592e-014	1.0209e-003	1.3800e-012	5.1060e-008
Co-60	5.2584e-012	1.9456e-001	2.6300e-010	9.7310e-006
Cs-134	4.0988e-013	1.5165e-002	2.0500e-011	7.5850e-007
Cs-137	4.9585e-011	1.8346e+000	2.4800e-009	9.1760e-005
Fe-55	4.3387e-013	1.6053e-002	2.1700e-011	8.0290e-007
H-3	2.1194e-012	7.8416e-002	1.0600e-010	3.9220e-006
Ni-63	3.1990e-011	1.1836e+000	1.6000e-009	5.9200e-005
Sr-90	2.5192e-013	9.3212e-003	1.2600e-011	4.6620e-007
Y-90	2.5192e-013	9.3212e-003	1.2600e-011	4.6620e-007

Buildup
The material reference is : Air Gap

Integration Parameters

Z Direction	20
Y Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	3.798e-02	7.091e-09	7.462e-09	5.906e-11	6.215e-11
0.0318	3.251e-05	6.069e-12	6.387e-12	5.056e-14	5.320e-14
0.0322	7.008e-02	1.325e-08	1.394e-08	1.066e-10	1.122e-10
0.0322	5.999e-05	1.134e-11	1.193e-11	9.125e-14	9.602e-14

Page : 2
DOS File: CC2.MS5
Run Date: May 1, 2001
Run Time: 4:37:12 PM
Duration: 00:00:05

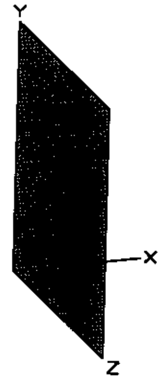
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0364	2.550e-02	5.481e-09	5.766e-09	3.114e-11	3.276e-11
0.0364	2.183e-05	4.691e-12	4.936e-12	2.665e-14	2.804e-14
0.1221	8.730e-04	6.389e-10	6.599e-10	1.002e-12	1.035e-12
0.1365	1.082e-04	8.864e-11	9.138e-11	1.425e-13	1.469e-13
0.2769	5.369e-06	8.954e-12	9.110e-12	1.680e-14	1.709e-14
0.4753	2.214e-04	6.358e-10	6.433e-10	1.248e-12	1.262e-12
0.536	2.926e-07	9.481e-13	9.583e-13	1.859e-15	1.879e-15
0.5632	1.271e-03	4.328e-09	4.373e-09	8.473e-12	8.562e-12
0.5693	2.340e-03	8.055e-09	8.139e-09	1.576e-11	1.593e-11
0.6047	1.480e-02	5.413e-08	5.467e-08	1.056e-10	1.067e-10
0.6616	1.651e+00	6.609e-06	6.670e-06	1.281e-08	1.293e-08
0.692	1.632e-06	6.836e-12	6.897e-12	1.320e-14	1.332e-14
0.6938	3.174e-05	1.333e-10	1.345e-10	2.573e-13	2.596e-13
0.7958	1.295e-02	6.242e-08	6.292e-08	1.188e-10	1.197e-10
0.8019	1.324e-03	6.430e-09	6.481e-09	1.223e-11	1.232e-11
1.0386	1.517e-04	9.550e-10	9.613e-10	1.749e-12	1.760e-12
1.1679	2.730e-04	1.934e-09	1.946e-09	3.459e-12	3.480e-12
1.1732	1.946e-01	1.385e-06	1.393e-06	2.474e-09	2.489e-09
1.3325	1.946e-01	1.573e-06	1.582e-06	2.730e-09	2.745e-09
1.3652	4.610e-04	3.820e-09	3.841e-09	6.588e-12	6.624e-12
TOTALS:	2.208e+00	9.736e-06	9.817e-06	1.849e-08	1.865e-08

Page : 1
DOS File: CC4.MS5
Run Date: May 1, 2001
Run Time: 4:33:22 PM
Duration: 00:00:05

Attachment 6-15
Page 8 of 19

File Ref:
Date: 5/1/01
By: RFD
Checked:

Case Title: AF 4 m^2
Description: Contaminated Concrete
Geometry: 4 - Rectangular Area - Vertical



Source Dimensions

Width	200.0 cm	6 ft 6.7 in
Height	200.0 cm	6 ft 6.7 in

Dose Points

	X	Y	Z
# 1	100 cm 3 ft 3.4 in	100 cm 3 ft 3.4 in	100 cm 3 ft 3.4 in

Shields

Shield Name	Material	Density
Air Gap	Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 24
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	µCi/cm²	Bq/cm²
Ba-137m	9.9200e-011	3.6704e+000	2.4800e-009	9.1760e-005
Co-57	5.5200e-014	2.0424e-003	1.3800e-012	5.1060e-008
Co-60	1.0520e-011	3.8924e-001	2.6300e-010	9.7310e-006
Cs-134	8.2000e-013	3.0340e-002	2.0500e-011	7.5850e-007
Cs-137	9.9200e-011	3.6704e+000	2.4800e-009	9.1760e-005
Fe-55	8.6800e-013	3.2116e-002	2.1700e-011	8.0290e-007
H-3	4.2400e-012	1.5688e-001	1.0600e-010	3.9220e-006
Ni-63	6.4000e-011	2.3680e+000	1.6000e-009	5.9200e-005
Sr-90	5.0400e-013	1.8648e-002	1.2600e-011	4.6620e-007
Y-90	5.0400e-013	1.8648e-002	1.2600e-011	4.6620e-007

Buildup
The material reference is : Air Gap

Integration Parameters

Z Direction	20
Y Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	7.599e-02	1.176e-08	1.243e-08	9.796e-11	1.036e-10
0.0318	6.504e-05	1.007e-11	1.064e-11	8.385e-14	8.864e-14
0.0322	1.402e-01	2.197e-08	2.323e-08	1.768e-10	1.869e-10
0.0322	1.200e-04	1.881e-11	1.988e-11	1.514e-13	1.600e-13

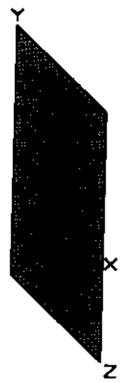
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0364	5.102e-02	9.095e-09	9.613e-09	5.167e-11	5.462e-11
0.0364	4.367e-05	7.785e-12	8.229e-12	4.423e-14	5.462e-11
0.1221	1.746e-03	[illegible]	[illegible]	[illegible]	4.675e-14
0.1385	[illegible]	1.473e-10	1.583e-10	[illegible]	[illegible]
0.2769	1.074e-05	1.489e-11	1.517e-11	2.369e-13	2.449e-13
0.4753	4.430e-04	1.057e-09	1.071e-09	2.792e-14	2.846e-14
0.536	5.854e-07	1.577e-12	1.595e-12	2.074e-12	2.101e-12
0.5632	2.542e-03	7.197e-09	7.279e-09	3.092e-15	3.129e-15
0.5693	4.681e-03	1.340e-08	1.355e-08	1.409e-11	1.425e-11
0.6047	2.961e-02	9.003e-08	9.100e-08	2.622e-11	2.651e-11
0.6616	3.303e+00	1.099e-05	1.110e-05	1.756e-10	1.775e-10
0.692	3.266e-06	1.137e-11	1.148e-11	2.131e-08	2.152e-08
0.6938	6.349e-05	2.216e-10	2.238e-10	2.196e-14	2.217e-14
0.7958	2.591e-02	1.038e-07	1.047e-07	4.279e-13	4.321e-13
0.8019	2.649e-03	1.069e-08	1.079e-08	1.976e-10	1.993e-10
1.0386	3.034e-04	1.589e-09	1.600e-09	2.034e-11	2.051e-11
1.1679	5.461e-04	3.217e-09	3.239e-09	2.909e-12	2.930e-12
1.1732	3.892e-01	2.303e-06	2.319e-06	5.755e-12	5.793e-12
1.3325	3.892e-01	2.618e-06	2.633e-06	4.116e-09	4.144e-09
1.3652	9.223e-04	6.356e-09	6.393e-09	4.541e-09	4.569e-09
				1.096e-11	1.102e-11
TOTALS:	4.418e+00	1.619e-05	1.634e-05	3.075e-08	3.104e-08

Page : 1
DOS File: CC8.MS5
Run Date: May 1, 2001
Run Time: 4:32:20 PM
Duration: 00:00:05

Attachment 6-15
Page 10 of 19

File Ref:
Date: 5/1/01
By: RTD
Checked:

Case Title: AF 8 m^2
Description: Contaminated Concrete
Geometry: 4 - Rectangular Area - Vertical



Source Dimensions

Width	282.8 cm	9 ft 3.3 in
Height	282.8 cm	9 ft 3.3 in

Dose Points

	X	Y	Z
# 1	100 cm	141.4 cm	141.4 cm
	3 ft 3.4 in	4 ft 7.7 in	4 ft 7.7 in

Shields

Shield Name	Material	Density
Air Gap	Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm²	Bq/cm²
Ba-137m	1.9834e-010	7.3386e+000	2.4800e-009	9.1760e-005
Co-57	1.1037e-013	4.0836e-003	1.3800e-012	5.1060e-008
Co-60	2.1034e-011	7.7824e-001	2.6300e-010	9.7310e-006
Cs-134	1.6395e-012	6.0662e-002	2.0500e-011	7.5850e-007
Cs-137	1.9834e-010	7.3386e+000	2.4800e-009	9.1760e-005
Fe-55	1.7355e-012	6.4213e-002	2.1700e-011	8.0290e-007
H-3	8.4774e-012	3.1367e-001	1.0600e-010	3.9220e-006
Ni-63	1.2796e-010	4.7346e+000	1.6000e-009	5.9200e-005
Sr-90	1.0077e-012	3.7285e-002	1.2600e-011	4.6620e-007
Y-90	1.0077e-012	3.7285e-002	1.2600e-011	4.6620e-007

Buildup
The material reference is : Air Gap

Integration Parameters

Z Direction	20
Y Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	1.519e-01	1.801e-08	1.918e-08	1.501e-10	1.598e-10
0.0318	1.300e-04	1.542e-11	1.642e-11	1.284e-13	1.367e-13
0.0322	2.803e-01	3.366e-08	3.583e-08	2.709e-10	2.884e-10
0.0322	2.399e-04	2.881e-11	3.067e-11	2.319e-13	2.469e-13
0.0364	1.020e-01	1.394e-08	1.484e-08	7.922e-11	8.433e-11
0.0364	8.732e-05	1.194e-11	1.270e-11	6.781e-14	7.218e-14
0.1221	3.492e-03	1.631e-09	1.697e-09	2.558e-12	2.661e-12
0.1365	4.330e-04	2.263e-10	2.350e-10	3.639e-13	3.779e-13

DOS File: CC8.MS5
Run Date: May 1, 2001
Run Time: 4:32:20 PM
Duration: 00:00:05

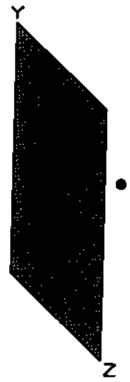
Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.2769	2.147e-05	2.288e-11	2.338e-11	4.293e-14	4.385e-14
0.4753	8.857e-04	1.626e-09	1.650e-09	3.191e-12	3.237e-12
0.536	1.170e-06	2.425e-12	2.457e-12	4.756e-15	4.819e-15
0.5632	5.083e-03	1.107e-08	1.121e-08	2.167e-11	2.195e-11
0.5693	9.360e-03	2.061e-08	2.087e-08	4.033e-11	4.084e-11
0.6047	5.921e-02	1.385e-07	1.402e-07	2.702e-10	2.735e-10
0.6616	6.603e+00	1.691e-05	1.710e-05	3.278e-08	3.315e-08
0.692	6.530e-06	1.749e-11	1.768e-11	3.378e-14	3.415e-14
0.6938	1.269e-04	3.410e-10	3.447e-10	6.583e-13	6.655e-13
0.7958	5.181e-02	1.597e-07	1.613e-07	3.040e-10	3.070e-10
0.8019	5.296e-03	1.645e-08	1.662e-08	3.129e-11	3.159e-11
1.0386	6.066e-04	2.444e-09	2.464e-09	4.476e-12	4.512e-12
1.1679	1.092e-03	4.951e-09	4.988e-09	8.856e-12	8.922e-12
1.1732	7.782e-01	3.545e-06	3.571e-06	6.334e-09	6.382e-09
1.3325	7.782e-01	4.029e-06	4.056e-06	6.989e-09	7.037e-09
1.3652	1.844e-03	9.781e-09	9.847e-09	1.687e-11	1.698e-11
TOTALS:	8.834e+00	2.492e-05	2.517e-05	4.731e-08	4.782e-08

MicroShield v5.01 (5.01-00010)
Maine Yankee Atomic Power

Page : 1
DOS File: CC16.MS5
Run Date: May 1, 2001
Run Time: 4:29:41 PM
Duration: 00:00:05

File Ref:
Date: 5/1/01
By: RTD
Checked:

Case Title: AF 16 m^2
Description: Contaminated Concrete
Geometry: 4 - Rectangular Area - Vertical



Source Dimensions

Width	400.0 cm	13 ft 1.5 in
Height	400.0 cm	13 ft 1.5 in

Dose Points

	X	Y	Z
# 1	100 cm	200 cm	200 cm
	3 ft 3.4 in	6 ft 6.7 in	6 ft 6.7 in

Shields

Shield Name	Material	Density
Air Gap	Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm²	Bq/cm²
Ba-137m	3.9680e-010	1.4682e+001	2.4800e-009	9.1760e-005
Co-57	2.2080e-013	8.1696e-003	1.3800e-012	5.1060e-008
Co-60	4.2080e-011	1.5570e+000	2.6300e-010	9.7310e-006
Cs-134	3.2800e-012	1.2136e-001	2.0500e-011	7.5850e-007
Cs-137	3.9680e-010	1.4682e+001	2.4800e-009	9.1760e-005
Fe-55	3.4720e-012	1.2846e-001	2.1700e-011	8.0290e-007
H-3	1.6960e-011	6.2752e-001	1.0600e-010	3.9220e-006
Ni-63	2.5600e-010	9.4720e+000	1.6000e-009	5.9200e-005
Sr-90	2.0160e-012	7.4592e-002	1.2600e-011	4.6620e-007
Y-90	2.0160e-012	7.4592e-002	1.2600e-011	4.6620e-007

Buildup
The material reference is : Air Gap

Integration Parameters

Z Direction	20
Y Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	3.040e-01	2.552e-08	2.745e-08	2.126e-10	2.287e-10
0.0318	2.602e-04	2.185e-11	2.350e-11	1.820e-13	1.957e-13
0.0322	5.608e-01	4.769e-08	5.129e-08	3.838e-10	4.128e-10
0.0322	4.800e-04	4.082e-11	4.391e-11	3.285e-13	3.533e-13
0.0364	2.041e-01	1.978e-08	2.127e-08	1.124e-10	1.208e-10
0.0364	1.747e-04	1.693e-11	1.821e-11	9.619e-14	1.034e-13
0.1221	6.986e-03	2.321e-09	2.431e-09	3.639e-12	3.811e-12
0.1365	8.662e-04	3.221e-10	3.364e-10	5.179e-13	5.410e-13

DOS File: CC16.MS5
Run Date: May 1, 2001
Run Time: 4:29:41 PM
Duration: 00:00:05

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.2769	4.296e-05	3.259e-11	3.341e-11	6.113e-14	6.267e-14
0.4753	1.772e-03	2.317e-09	2.356e-09	4.546e-12	4.624e-12
0.536	2.342e-06	3.456e-12	3.510e-12	6.778e-15	6.883e-15
0.5632	1.017e-02	1.578e-08	1.601e-08	3.089e-11	3.135e-11
0.5693	1.873e-02	2.937e-08	2.980e-08	5.747e-11	5.833e-11
0.6047	1.184e-01	1.974e-07	2.002e-07	3.851e-10	3.906e-10
0.6616	1.321e+01	2.410e-05	2.442e-05	4.673e-08	4.734e-08
0.692	1.306e-05	2.493e-11	2.525e-11	4.815e-14	4.877e-14
0.6938	2.540e-04	4.860e-10	4.923e-10	9.384e-13	9.504e-13
0.7958	1.036e-01	2.277e-07	2.303e-07	4.334e-10	4.384e-10
0.8019	1.059e-02	2.346e-08	2.373e-08	4.461e-11	4.512e-11
1.0386	1.214e-03	3.486e-09	3.519e-09	6.383e-12	6.443e-12
1.1679	2.184e-03	7.060e-09	7.122e-09	1.263e-11	1.274e-11
1.1732	1.557e+00	5.055e-06	5.099e-06	9.034e-09	9.113e-09
1.3325	1.557e+00	5.746e-06	5.791e-06	9.969e-09	1.005e-08
1.3652	3.689e-03	1.395e-08	1.406e-08	2.406e-11	2.425e-11
TOTALS:	1.767e+01	3.552e-05	3.594e-05	6.744e-08	6.828e-08

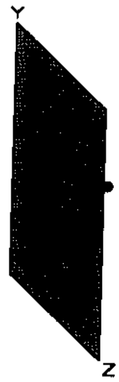
MicroShield v5.01 (5.01-00010)
Maine Yankee Atomic Power

Page : 1
DOS File: CC25.MS5
Run Date: May 1, 2001
Run Time: 4:28:13 PM
Duration: 00:00:05

Attachment 6-15
Page 14 of 19

File Ref:
Date: 5/1/01
By: RFD
Checked:

Case Title: AF 25 m^2
Description: Contaminated Concrete
Geometry: 4 - Rectangular Area - Vertical



Source Dimensions

Width	500.0 cm	16 ft 4.9 in
Height	500.0 cm	16 ft 4.9 in

Dose Points

	X	Y	Z
# 1	100 cm	250 cm	250 cm
	3 ft 3.4 in	8 ft 2.4 in	8 ft 2.4 in

Shields

Shield Name	Material	Density
Air Gap	Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 24
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm²	Bq/cm²
Ba-137m	6.2000e-010	2.2940e+001	2.4800e-009	9.1760e-005
Co-57	3.4500e-013	1.2765e-002	1.3800e-012	5.1060e-008
Co-60	6.5750e-011	2.4328e+000	2.6300e-010	9.7310e-006
Cs-134	5.1250e-012	1.8963e-001	2.0500e-011	7.5850e-007
Cs-137	6.2000e-010	2.2940e+001	2.4800e-009	9.1760e-005
Fe-55	5.4250e-012	2.0073e-001	2.1700e-011	8.0290e-007
H-3	2.6500e-011	9.8050e-001	1.0600e-010	3.9220e-006
Ni-63	4.0000e-010	1.4800e+001	1.6000e-009	5.9200e-005
Sr-90	3.1500e-012	1.1655e-001	1.2600e-011	4.6620e-007
Y-90	3.1500e-012	1.1655e-001	1.2600e-011	4.6620e-007

Buildup
The material reference is : Air Gap

Integration Parameters

Z Direction	20
Y Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	4.749e-01	3.077e-08	3.338e-08	2.563e-10	2.780e-10
0.0318	4.065e-04	2.634e-11	2.857e-11	2.194e-13	2.380e-13
0.0322	8.762e-01	5.750e-08	6.238e-08	4.628e-10	5.020e-10
0.0322	7.500e-04	4.922e-11	5.339e-11	3.961e-13	4.297e-13

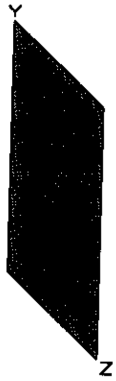
DOS File: CC25.MS5
Run Date: May 1, 2001
Run Time: 4:28:13 PM
Duration: 00:00:05

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0364	3.189e-01	2.387e-08	2.589e-08	1.356e-10	1.471e-10
0.0364	2.729e-04	2.043e-11	2.216e-11	1.161e-13	1.259e-13
0.1221	1.092e-02	2.808e-09	2.957e-09	4.403e-12	4.637e-12
0.1365	1.353e-03	3.897e-10	4.092e-10	6.267e-13	6.580e-13
0.2769	6.713e-05	3.946e-11	4.057e-11	7.403e-14	7.611e-14
0.4753	2.769e-03	2.807e-09	2.860e-09	5.508e-12	5.612e-12
0.536	3.659e-06	4.187e-12	4.260e-12	8.212e-15	8.354e-15
0.5632	1.589e-02	1.912e-08	1.944e-08	3.743e-11	3.806e-11
0.5693	2.926e-02	3.558e-08	3.617e-08	6.964e-11	7.080e-11
0.6047	1.851e-01	2.392e-07	2.430e-07	4.666e-10	4.740e-10
0.6616	2.064e+01	2.921e-05	2.964e-05	5.662e-08	5.746e-08
0.692	2.041e-05	3.022e-11	3.065e-11	5.835e-14	5.919e-14
0.6938	3.968e-04	5.890e-10	5.974e-10	1.137e-12	1.153e-12
0.7958	1.619e-01	2.760e-07	2.795e-07	5.253e-10	5.320e-10
0.8019	1.655e-02	2.843e-08	2.879e-08	5.406e-11	5.475e-11
1.0386	1.896e-03	4.226e-09	4.270e-09	7.737e-12	7.819e-12
1.1679	3.413e-03	8.560e-09	8.643e-09	1.531e-11	1.546e-11
1.1732	2.433e+00	6.129e-06	6.188e-06	1.095e-08	1.106e-08
1.3325	2.433e+00	6.966e-06	7.028e-06	1.209e-08	1.219e-08
1.3652	5.765e-03	1.692e-08	1.706e-08	2.917e-11	2.942e-11
TOTALS:	2.761e+01	4.305e-05	4.362e-05	8.173e-08	8.288e-08

Page : 1
DOS File: CC50.MS5
Run Date: May 1, 2001
Run Time: 3:28:47 PM
Duration: 00:00:05

File Ref:
Date: 5/1/01
By: RTD
Checked:

Case Title: AF 50 m^2
Description: Contaminated Concrete
Geometry: 4 - Rectangular Area - Vertical



Source Dimensions

Width	707.1 cm	23 ft 2.4 in
Height	707.1 cm	23 ft 2.4 in

Dose Points

	X	Y	Z
# 1	100 cm	353.6 cm	353.6 cm
	3 ft 3.4 in	11 ft 7.2 in	11 ft 7.2 in

Shields

Shield Name	Material	Density
Air Gap	Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 24
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm²	Bq/cm²
Ba-137m	1.2400e-009	4.5879e+001	2.4800e-009	9.1760e-005
Co-57	6.8999e-013	2.5530e-002	1.3800e-012	5.1060e-008
Co-60	1.3150e-010	4.8654e+000	2.6300e-010	9.7310e-006
Cs-134	1.0250e-011	3.7924e-001	2.0500e-011	7.5850e-007
Cs-137	1.2400e-009	4.5879e+001	2.4800e-009	9.1760e-005
Fe-55	1.0850e-011	4.0144e-001	2.1700e-011	8.0290e-007
H-3	5.2999e-011	1.9610e+000	1.0600e-010	3.9220e-006
Ni-63	7.9998e-010	2.9599e+001	1.6000e-009	5.9200e-005
Sr-90	6.2999e-012	2.3310e-001	1.2600e-011	4.6620e-007
Y-90	6.2999e-012	2.3310e-001	1.2600e-011	4.6620e-007

Buildup
The material reference is : Air Gap

Integration Parameters

Z Direction	20
Y Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	9.498e-01	3.920e-08	4.324e-08	3.265e-10	3.602e-10
0.0318	8.130e-04	3.355e-11	3.701e-11	2.795e-13	3.083e-13
0.0322	1.752e+00	7.327e-08	8.082e-08	5.896e-10	6.505e-10
0.0322	1.500e-03	6.271e-11	6.918e-11	5.047e-13	5.568e-13

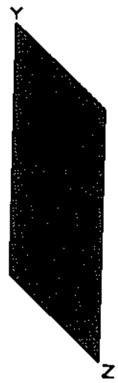
DOS File: CC50.MS5
Run Date: May 1, 2001
Run Time: 3:28:47 PM
Duration: 00:00:05

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0364	6.377e-01	3.047e-08	3.361e-08	1.731e-10	1.909e-10
0.0364	5.459e-04	2.608e-11	2.877e-11	1.482e-13	1.634e-13
0.1221	2.183e-02	3.603e-09	3.835e-09	5.648e-12	6.013e-12
0.1365	2.707e-03	5.001e-10	5.305e-10	8.041e-13	8.530e-13
0.2769	1.343e-04	5.070e-11	5.243e-11	9.511e-14	9.835e-14
0.4753	5.537e-03	3.610e-09	3.693e-09	7.083e-12	7.246e-12
0.536	7.318e-06	5.386e-12	5.499e-12	1.056e-14	1.078e-14
0.5632	3.178e-02	2.459e-08	2.509e-08	4.815e-11	4.912e-11
0.5693	5.852e-02	4.577e-08	4.669e-08	8.958e-11	9.138e-11
0.6047	3.701e-01	3.077e-07	3.136e-07	6.003e-10	6.119e-10
0.6616	4.128e+01	3.758e-05	3.826e-05	7.286e-08	7.416e-08
0.692	4.082e-05	3.888e-11	3.956e-11	7.509e-14	7.639e-14
0.6938	7.936e-04	7.579e-10	7.710e-10	1.463e-12	1.489e-12
0.7958	3.239e-01	3.552e-07	3.607e-07	6.761e-10	6.866e-10
0.8019	3.311e-02	3.659e-08	3.716e-08	6.958e-11	7.066e-11
1.0386	3.792e-03	5.441e-09	5.511e-09	9.962e-12	1.009e-11
1.1679	6.826e-03	1.102e-08	1.115e-08	1.972e-11	1.995e-11
1.1732	4.865e+00	7.892e-06	7.985e-06	1.410e-08	1.427e-08
1.3325	4.865e+00	8.973e-06	9.069e-06	1.557e-08	1.573e-08
1.3652	1.153e-02	2.179e-08	2.202e-08	3.757e-11	3.797e-11
TOTALS:	5.523e+01	5.541e-05	5.630e-05	1.052e-07	1.070e-07

Page : 1
DOS File: CC100.MS5
Run Date: May 1, 2001
Run Time: 3:27:03 PM
Duration: 00:00:05

File Ref:
Date: 5/1/01
By: RFD
Checked:

Case Title: AF 100 m^2
Description: Contaminated Concrete
Geometry: 4 - Rectangular Area - Vertical



Source Dimensions

Width	1.0e+3 cm	32 ft 9.7 in
Height	1.0e+3 cm	32 ft 9.7 in

Dose Points

	X	Y	Z
# 1	100 cm	500 cm	500 cm
	3 ft 3.4 in	16 ft 4.9 in	16 ft 4.9 in

Shields

Shield Name	Material	Density
Air Gap	Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	µCi/cm²	Bq/cm²
Ba-137m	2.4800e-009	9.1760e+001	2.4800e-009	9.1760e-005
Co-57	1.3800e-012	5.1060e-002	1.3800e-012	5.1060e-008
Co-60	2.6300e-010	9.7310e+000	2.6300e-010	9.7310e-006
Cs-134	2.0500e-011	7.5850e-001	2.0500e-011	7.5850e-007
Cs-137	2.4800e-009	9.1760e+001	2.4800e-009	9.1760e-005
Fe-55	2.1700e-011	8.0290e-001	2.1700e-011	8.0290e-007
H-3	1.0600e-010	3.9220e+000	1.0600e-010	3.9220e-006
Ni-63	1.6000e-009	5.9200e+001	1.6000e-009	5.9200e-005
Sr-90	1.2600e-011	4.6620e-001	1.2600e-011	4.6620e-007
Y-90	1.2600e-011	4.6620e-001	1.2600e-011	4.6620e-007

Buildup
The material reference is : Air Gap

Integration Parameters

Z Direction	20
Y Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	1.900e+00	4.758e-08	5.366e-08	3.963e-10	4.470e-10
0.0318	1.626e-03	4.073e-11	4.593e-11	3.392e-13	3.826e-13
0.0322	3.505e+00	8.896e-08	1.003e-07	7.160e-10	8.074e-10
0.0322	3.000e-03	7.615e-11	8.588e-11	6.128e-13	6.912e-13
0.0364	1.275e+00	3.708e-08	4.182e-08	2.107e-10	2.376e-10
0.0364	1.092e-03	3.174e-11	3.580e-11	1.803e-13	2.034e-13
0.1221	4.366e-02	4.413e-09	4.765e-09	6.919e-12	7.472e-12
0.1365	5.414e-03	6.128e-10	6.588e-10	9.853e-13	1.059e-12

DOS File: CC100.MS5
Run Date: May 1, 2001
Run Time: 3:27:03 PM
Duration: 00:00:05

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.2769	2.685e-04	6.223e-11	6.485e-11	1.167e-13	1.216e-13
0.4753	1.107e-02	4.436e-09	4.562e-09	8.705e-12	8.951e-12
0.536	1.464e-05	6.621e-12	6.792e-12	1.298e-14	1.332e-14
0.5632	6.356e-02	3.023e-08	3.099e-08	5.919e-11	6.067e-11
0.5693	1.170e-01	5.628e-08	5.767e-08	1.101e-10	1.129e-10
0.6047	7.403e-01	3.783e-07	3.873e-07	7.382e-10	7.556e-10
0.6616	8.257e+01	4.622e-05	4.724e-05	8.960e-08	9.158e-08
0.692	8.164e-05	4.782e-11	4.884e-11	9.236e-14	9.432e-14
0.6938	1.587e-03	9.323e-10	9.521e-10	1.800e-12	1.838e-12
0.7958	6.478e-01	4.370e-07	4.454e-07	8.318e-10	8.477e-10
0.8019	6.622e-02	4.502e-08	4.588e-08	8.561e-11	8.724e-11
1.0386	7.585e-03	6.697e-09	6.803e-09	1.226e-11	1.246e-11
1.1679	1.365e-02	1.357e-08	1.377e-08	2.428e-11	2.463e-11
1.1732	9.731e+00	9.717e-06	9.858e-06	1.737e-08	1.762e-08
1.3325	9.731e+00	1.105e-05	1.120e-05	1.917e-08	1.942e-08
1.3652	2.306e-02	2.683e-08	2.718e-08	4.627e-11	4.687e-11
TOTALS:	1.105e+02	6.816e-05	6.952e-05	1.294e-07	1.321e-07

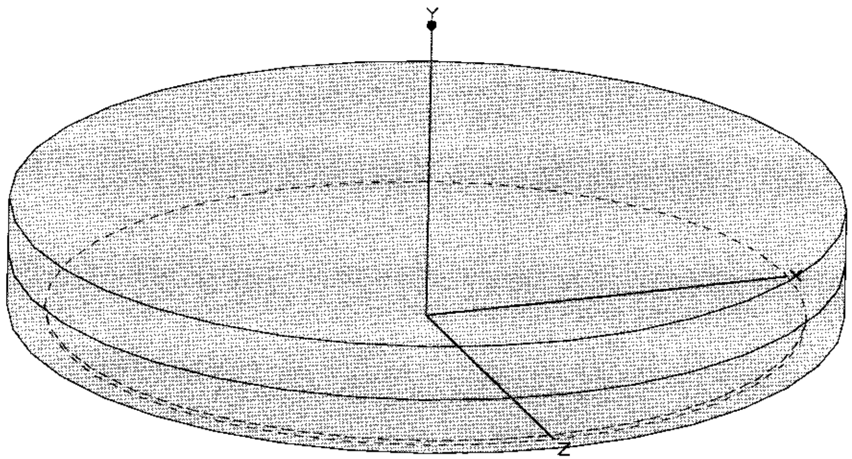
Attachment 6-16
Forebay Sediment Dose Assessment

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : FBRR.MS5
Run Date : March 18, 2001
Run Time : 4:13:57 PM
Duration : 00:00:03

File Ref: 004.01 (MY)
Date: 3/19/01
By: [illegible]
Checked:

Case Title: Forebay riprap
Description: Case 1
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	2.54 cm	1.0 in
Radius	200.0 cm	6 ft 6.7 in

Dose Points

	X	Y	Z
# 1	0 cm	162.54 cm	0 cm
	0.0 in	5 ft 4.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	3.19e+05 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	5.1935e-007	1.9216e+004	1.6271e-006	6.0203e-002
Co-60	1.0482e-005	3.8784e+005	3.2840e-005	1.2151e+000
Cs-137	5.4900e-007	2.0313e+004	1.7200e-006	6.3640e-002
Sb-125	9.2564e-008	3.4249e+003	2.9000e-007	1.0730e-002

Buildup
The material reference is : Shield 2

Integration Parameters

Radial 20

DOS File : FBRR.MS5
Run Date : March 18, 2001
Run Time: 4:13:57 PM
Duration : 00:00:03

Circumferential 10
Y Direction (axial) 10

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	2.671e+03	8.075e-39	6.578e-29	8.003e-41	6.519e-31
0.04	4.097e+02	2.991e-23	5.692e-21	1.323e-25	2.517e-23
0.1	8.940e+00	4.841e-13	3.309e-10	7.405e-16	5.063e-13
0.15	8.596e+00	6.947e-12	2.781e-09	1.144e-14	4.579e-12
0.2	2.599e+02	9.320e-10	2.216e-07	1.645e-12	3.912e-10
0.3	1.428e+01	3.459e-10	3.642e-08	6.561e-13	6.908e-11
0.4	1.072e+03	9.506e-08	5.642e-06	1.852e-10	1.099e-08
0.5	3.546e+02	8.323e-08	3.235e-06	1.634e-10	6.349e-09
0.6	1.858e+04	9.448e-06	2.643e-04	1.844e-08	5.159e-07
1.0	3.878e+05	1.546e-03	1.909e-02	2.849e-06	3.518e-05
1.5	3.878e+05	6.925e-03	4.980e-02	1.165e-05	8.378e-05
TOTALS:	7.991e+05	8.480e-03	6.916e-02	1.452e-05	1.195e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\FBRR.MS5
Case Title: Forebay riprap
This case was run on Sunday, March 18, 2001 at 4:13:57 PM
Dose Point # 1 - (0,162.54,0) cm

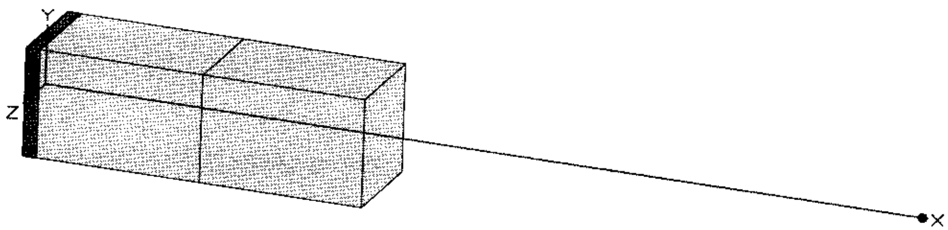
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.178e-003	5.275e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.480e-003	6.916e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.452e-005	1.195e-004
Absorbed Dose Rate in Air	mGy/hr	1.268e-007	1.043e-006
"	mrad/hr	1.268e-005	1.043e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.438e-007	1.185e-006
o Opposed	"	1.247e-007	1.024e-006
o Rotational	"	1.247e-007	1.024e-006
o Isotropic	"	1.117e-007	9.160e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.524e-007	1.258e-006
o Opposed	"	1.472e-007	1.214e-006
o Rotational	"	1.472e-007	1.214e-006
o Isotropic	"	1.178e-007	9.676e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.295e-007	1.067e-006
o Posterior/Anterior	"	1.198e-007	9.847e-007
o Lateral	"	9.625e-008	7.875e-007
o Rotational	"	1.081e-007	8.877e-007
o Isotropic	"	9.609e-008	7.872e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : FBINF.MS5
Run Date : March 18, 2001
Run Time : 4:13:03 PM
Duration : 00:00:01

File Ref: 004-01 (MV)
Date: 3/19/01
By: [illegible]
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 16 - Infinite Slab



Source Dimensions

Thickness	2.54 cm	1.0 in

Dose Points

	X	Y	Z
# 1	162.54 cm 5 ft 4.0 in	0 cm 0.0 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	Infinite	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	μCi/cm³	Bq/cm³
Ba-137m	1.6271e-006	6.0203e-002
Co-60	3.2840e-005	1.2151e+000
Cs-137	1.7200e-006	6.3640e-002
Sb-125	2.9000e-007	1.0730e-002

Buildup
The material reference is : Shield 2

Results

DOS File : FBINF.MS5
Run Date: March 18, 2001
Run Time: 4:13:03 PM
Duration : 00:00:01

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	8.367e-03	8.079e-39	9.742e-37	8.007e-41	9.655e-39
0.04	1.284e-03	2.990e-23	5.799e-21	1.322e-25	2.565e-23
0.1	2.801e-05	4.842e-13	3.131e-10	7.407e-16	4.790e-13
0.15	2.693e-05	6.953e-12	2.723e-09	1.145e-14	4.485e-12
0.2	8.144e-04	9.336e-10	2.092e-07	1.648e-12	3.692e-10
0.3	4.475e-05	3.472e-10	3.927e-08	6.587e-13	7.450e-11
0.4	3.360e-03	9.569e-08	6.105e-06	1.864e-10	1.190e-08
0.5	1.111e-03	8.406e-08	3.623e-06	1.650e-10	7.112e-09
0.6	5.822e-02	9.579e-06	2.950e-04	1.870e-08	5.757e-07
1.0	1.215e+00	1.595e-03	2.215e-02	2.940e-06	4.083e-05
1.5	1.215e+00	7.328e-03	5.741e-02	1.233e-05	9.658e-05
TOTALS:	2.503e+00	8.933e-03	7.986e-02	1.529e-05	1.380e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\FBINF.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 4:13:03 PM
Dose Point # 1 - (162.54,0,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.497e-003	6.094e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.933e-003	7.986e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.529e-005	1.380e-004
Absorbed Dose Rate in Air	mGy/hr	1.335e-007	1.205e-006
"	mrad/hr	1.335e-005	1.205e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.514e-007	1.369e-006
o Opposed	"	1.314e-007	1.183e-006
o Rotational	"	1.314e-007	1.183e-006
o Isotropic	"	1.176e-007	1.058e-006
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.605e-007	1.453e-006
o Opposed	"	1.550e-007	1.402e-006
o Rotational	"	1.550e-007	1.402e-006
o Isotropic	"	1.241e-007	1.117e-006
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.363e-007	1.232e-006
o Posterior/Anterior	"	1.262e-007	1.137e-006
o Lateral	"	1.014e-007	9.094e-007
o Rotational	"	1.138e-007	1.025e-006
o Isotropic	"	1.012e-007	9.092e-007

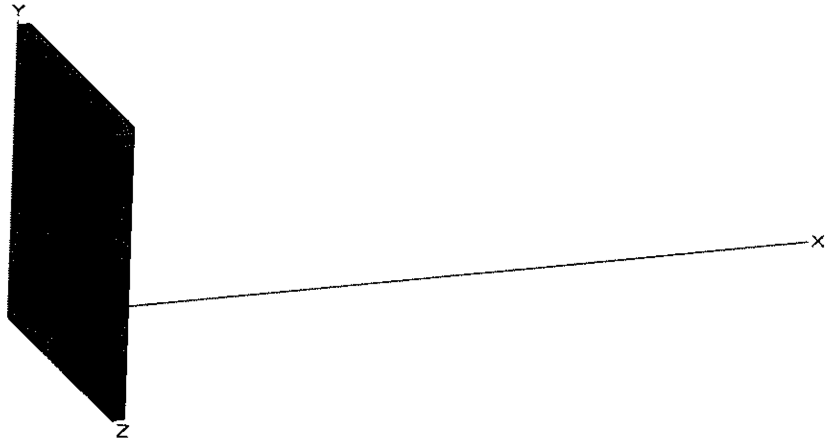
Attachment 6-16
Page 7 of 65

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : SG.MS5
Run Date : March 18, 2001
Run Time : 4:14:50 PM
Duration : 00:00:17

File Ref: 004-01(my)
Date: 3/19/01
By: [illegible]
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	2.54 cm	1.0 in
Width	60.0 cm	1 ft 11.6 in
Height	60.0 cm	1 ft 11.6 in

Dose Points

	X	Y	Z
# 1	162.54 cm 5 ft 4.0 in	30 cm 11.8 in	30 cm 11.8 in

Shields

Shield Name	Dimension	Material	Density
Source	9144.0 cm³	SiO2	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	1.4878e-008	5.5050e+002	1.6271e-006	6.0203e-002
Co-60	3.0029e-007	1.1111e+004	3.2840e-005	1.2151e+000
Cs-137	1.5728e-008	5.8192e+002	1.7200e-006	6.3640e-002
Sb-125	2.6518e-009	9.8115e+001	2.9000e-007	1.0730e-002

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20

DOS File : SG.MS5
Run Date: March 18, 2001
Run Time: 4:14:50 PM
Duration : 00:00:17

Z Direction

20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	7.651e+01	1.633e-06	2.088e-06	1.619e-08	2.070e-08
0.04	1.174e+01	5.858e-07	8.676e-07	2.591e-09	3.837e-09
0.1	2.561e-01	5.415e-08	8.791e-08	8.285e-11	1.345e-10
0.15	2.462e-01	8.229e-08	1.210e-07	1.355e-10	1.993e-10
0.2	7.447e+00	3.412e-06	4.709e-06	6.023e-09	8.310e-09
0.3	4.092e-01	2.914e-07	3.724e-07	5.528e-10	7.064e-10
0.4	3.072e+01	2.987e-05	3.658e-05	5.821e-08	7.127e-08
0.5	1.016e+01	1.257e-05	1.494e-05	2.467e-08	2.933e-08
0.6	5.324e+02	8.015e-04	9.325e-04	1.565e-06	1.820e-06
1.0	1.111e+04	2.891e-02	3.207e-02	5.329e-05	5.912e-05
1.5	1.111e+04	4.448e-02	4.801e-02	7.484e-05	8.078e-05
TOTALS:	2.289e+04	7.424e-02	8.108e-02	1.298e-04	1.419e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\SG.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 4:14:50 PM
Dose Point # 1 - (162.54,30,30) cm

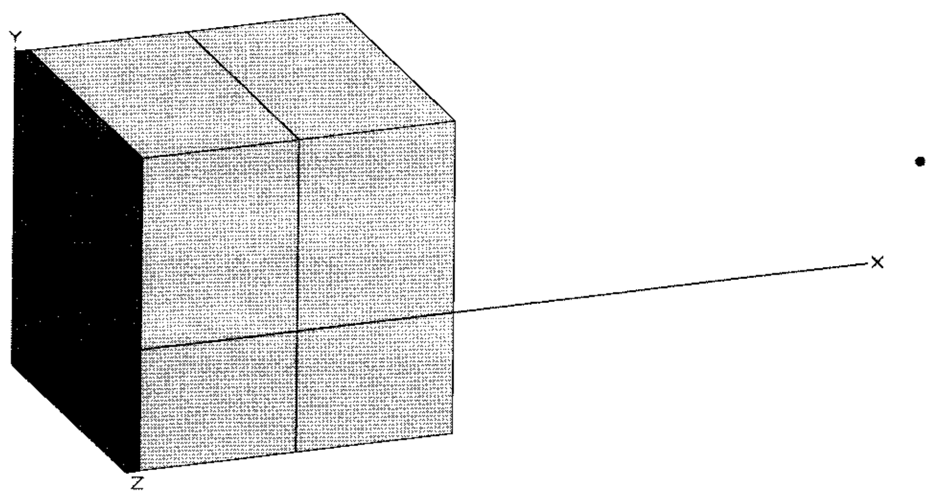
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.009e-002	6.587e-002
Photon Energy Fluence Rate	MeV/cm²/sec	7.424e-002	8.108e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.298e-004	1.419e-004
Absorbed Dose Rate in Air	mGy/hr	1.133e-006	1.238e-006
"	mrad/hr	1.133e-004	1.238e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.290e-006	1.410e-006
o Opposed	"	1.109e-006	1.212e-006
o Rotational	"	1.109e-006	1.212e-006
o Isotropic	"	9.904e-007	1.082e-006
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.371e-006	1.499e-006
o Opposed	"	1.321e-006	1.444e-006
o Rotational	"	1.321e-006	1.444e-006
o Isotropic	"	1.048e-006	1.145e-006
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.160e-006	1.268e-006
o Posterior/Anterior	"	1.068e-006	1.167e-006
o Lateral	"	8.487e-007	9.271e-007
o Rotational	"	9.616e-007	1.051e-006
o Isotropic	"	8.500e-007	9.286e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : SGC.MS5
Run Date : March 18, 2001
Run Time : 4:15:58 PM
Duration : 00:00:19

File Ref: 004-01 (mv)
Date: 3/18/01
By: [illegible]
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	2.54 cm	1.0 in
Width	60.0 cm	1 ft 11.6 in
Height	60.0 cm	1 ft 11.6 in

Dose Points

	X	Y	Z
# 1	162.54 cm	30 cm	30 cm
	5 ft 4.0 in	11.8 in	11.8 in

Shields

Shield Name	Dimension	Material	Density
Source	9144.0 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	1.4878e-008	5.5050e+002	1.6271e-006	6.0203e-002
Co-60	3.0029e-007	1.1111e+004	3.2840e-005	1.2151e+000
Cs-137	1.5728e-008	5.8192e+002	1.7200e-006	6.3640e-002
Sb-125	2.6518e-009	9.8115e+001	2.9000e-007	1.0730e-002

Buildup
The material reference is : Source

Integration Parameters

DOS File : SGC.MS5
Run Date: March 18, 2001
Run Time: 4:15:58 PM
Duration : 00:00:19

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	7.651e+01	6.459e-39	1.643e-31	6.402e-41	1.628e-33
0.04	1.174e+01	1.707e-23	1.273e-22	7.550e-26	5.631e-25
0.1	2.561e-01	1.272e-13	9.427e-12	1.947e-16	1.442e-14
0.15	2.462e-01	1.585e-12	1.299e-10	2.611e-15	2.140e-13
0.2	7.447e+00	1.954e-10	1.354e-08	3.449e-13	2.389e-11
0.3	4.092e-01	6.438e-11	2.895e-09	1.221e-13	5.492e-12
0.4	3.072e+01	1.618e-08	4.989e-07	3.152e-11	9.720e-10
0.5	1.016e+01	1.318e-08	2.977e-07	2.587e-11	5.844e-10
0.6	5.324e+02	1.409e-06	2.475e-05	2.750e-09	4.831e-08
1.0	1.111e+04	1.934e-04	1.738e-03	3.565e-07	3.203e-06
1.5	1.111e+04	7.528e-04	4.242e-03	1.267e-06	7.136e-06
TOTALS:	2.289e+04	9.477e-04	6.005e-03	1.626e-06	1.039e-05

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\SGC.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 4:15:58 PM
Dose Point # 1 - (162.54,30,30) cm

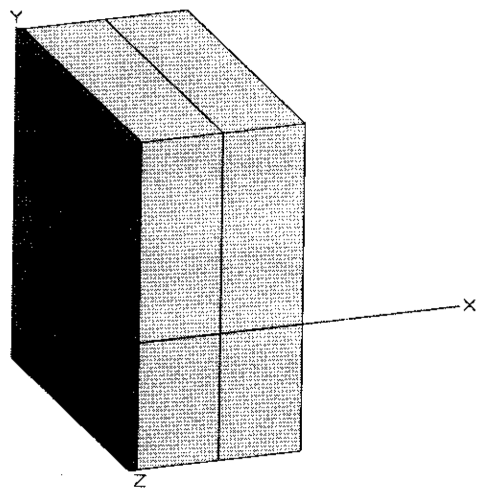
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.977e-004	4.609e-003
Photon Energy Fluence Rate	MeV/cm²/sec	9.477e-004	6.005e-003
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.626e-006	1.039e-005
Absorbed Dose Rate in Air	mGy/hr	1.419e-008	9.070e-008
"	mrad/hr	1.419e-006	9.070e-006
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.610e-008	1.031e-007
o Opposed	"	1.396e-008	8.902e-008
o Rotational	"	1.396e-008	8.902e-008
o Isotropic	"	1.250e-008	7.960e-008
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.708e-008	1.094e-007
o Opposed	"	1.650e-008	1.055e-007
o Rotational	"	1.650e-008	1.055e-007
o Isotropic	"	1.319e-008	8.410e-008
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.450e-008	9.276e-008
o Posterior/Anterior	"	1.341e-008	8.559e-008
o Lateral	"	1.076e-008	6.841e-008
o Rotational	"	1.210e-008	7.716e-008
o Isotropic	"	1.075e-008	6.840e-008

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X1SC.MS5
Run Date: March 18, 2001
Run Time: 4:00:18 PM
Duration : 00:00:20

File Ref: 004.01 (MY)
Date: 3/19/01
By:
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	2.54 cm	1.0 in
Width	120.0 cm	3 ft 11.2 in
Height	120.0 cm	3 ft 11.2 in

Dose Points

	X	Y	Z
# 1	162.54 cm 5 ft 4.0 in	60 cm 1 ft 11.6 in	60 cm 1 ft 11.6 in

Shields

Shield Name	Dimension	Material	Density
Source	3.66e+04 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	5.9514e-008	2.2020e+003	1.6271e-006	6.0203e-002
Co-60	1.2012e-006	4.4443e+004	3.2840e-005	1.2151e+000
Cs-137	6.2911e-008	2.3277e+003	1.7200e-006	6.3640e-002
Sb-125	1.0607e-008	3.9246e+002	2.9000e-007	1.0730e-002

Buildup
The material reference is : Source

Integration Parameters

Page : 2
DOS File : 4X1SC.MS5
Run Date: March 18, 2001
Run Time: 4:00:18 PM
Duration : 00:00:20

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	3.060e+02	8.052e-39	6.170e-31	7.980e-41	6.115e-33
0.04	4.695e+01	2.863e-23	2.144e-22	1.266e-25	9.484e-25
0.1	1.024e+00	3.323e-13	2.563e-11	5.084e-16	3.920e-14
0.15	9.850e-01	4.360e-12	3.750e-10	7.179e-15	6.175e-13
0.2	2.979e+01	5.524e-10	4.025e-08	9.750e-13	7.104e-11
0.3	1.637e+00	1.886e-10	8.909e-09	3.577e-13	1.690e-11
0.4	1.229e+02	4.855e-08	1.568e-06	9.460e-11	3.056e-09
0.5	4.063e+01	4.028e-08	9.505e-07	7.907e-11	1.866e-09
0.6	2.130e+03	4.368e-06	8.000e-05	8.526e-09	1.562e-07
1.0	4.444e+04	6.230e-04	5.794e-03	1.148e-06	1.068e-05
1.5	4.444e+04	2.492e-03	1.445e-02	4.192e-06	2.432e-05
TOTALS:	9.157e+04	3.119e-03	2.033e-02	5.349e-06	3.516e-05

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X1SC.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 4:00:18 PM
Dose Point # 1 - (162.54,60,60) cm

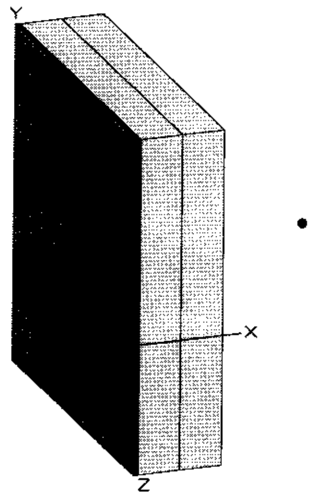
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	2.292e-003	1.557e-002
Photon Energy Fluence Rate	MeV/cm²/sec	3.119e-003	2.033e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	5.349e-006	3.516e-005
Absorbed Dose Rate in Air	mGy/hr	4.670e-008	3.069e-007
"	mrad/hr	4.670e-006	3.069e-005
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	5.298e-008	3.487e-007
o Opposed	"	4.594e-008	3.013e-007
o Rotational	"	4.594e-008	3.013e-007
o Isotropic	"	4.112e-008	2.694e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	5.618e-008	3.702e-007
o Opposed	"	5.426e-008	3.571e-007
o Rotational	"	5.426e-008	3.571e-007
o Isotropic	"	4.338e-008	2.846e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	4.771e-008	3.139e-007
o Posterior/Anterior	"	4.413e-008	2.897e-007
o Lateral	"	3.542e-008	2.316e-007
o Rotational	"	3.981e-008	2.611e-007
o Isotropic	"	3.537e-008	2.315e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X2SC.MS5
Run Date: March 18, 2001
Run Time: 4:04:53 PM
Duration : 00:00:19

File Ref: 004-01(MY)
Date: 3/18/01
By: [signature]
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	2.54 cm	1.0 in
Width	240.0 cm	7 ft 10.5 in
Height	240.0 cm	7 ft 10.5 in

Dose Points

	X	Y	Z
# 1	162.54 cm	120 cm	120 cm
	5 ft 4.0 in	3 ft 11.2 in	3 ft 11.2 in

Shields

Shield Name	Dimension	Material	Density
Source	1.46e+05 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.3805e-007	8.8080e+003	1.6271e-006	6.0203e-002
Co-60	4.8046e-006	1.7777e+005	3.2840e-005	1.2151e+000
Cs-137	2.5164e-007	9.3108e+003	1.7200e-006	6.3640e-002
Sb-125	4.2428e-008	1.5698e+003	2.9000e-007	1.0730e-002

Buildup
The material reference is : Source

Integration Parameters

Page : 2
DOS File : 4X2SC.MS5
Run Date: March 18, 2001
Run Time: 4:04:53 PM
Duration : 00:00:19

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	1.224e+03	8.075e-39	2.020e-30	8.003e-41	2.002e-32
0.04	1.878e+02	2.991e-23	2.243e-22	1.323e-25	9.920e-25
0.1	4.098e+00	4.754e-13	3.873e-11	7.273e-16	5.925e-14
0.15	3.940e+00	6.726e-12	6.253e-10	1.108e-14	1.030e-12
0.2	1.191e+02	8.921e-10	7.098e-08	1.575e-12	1.253e-10
0.3	6.547e+00	3.246e-10	1.684e-08	6.157e-13	3.195e-11
0.4	4.915e+02	8.760e-08	3.108e-06	1.707e-10	6.055e-09
0.5	1.625e+02	7.545e-08	1.951e-06	1.481e-10	3.830e-09
0.6	8.518e+03	8.438e-06	1.692e-04	1.647e-08	3.302e-07
1.0	1.778e+05	1.313e-03	1.326e-02	2.421e-06	2.443e-05
1.5	1.778e+05	5.620e-03	3.506e-02	9.455e-06	5.899e-05
TOTALS:	3.663e+05	6.942e-03	4.849e-02	1.189e-05	8.376e-05

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X2SC.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 4:04:53 PM
Dose Point # 1 - (162.54,120,120) cm

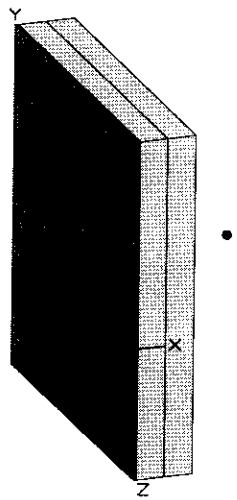
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	5.074e-003	3.692e-002
Photon Energy Fluence Rate	MeV/cm²/sec	6.942e-003	4.849e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.189e-005	8.376e-005
Absorbed Dose Rate in Air	mGy/hr	1.038e-007	7.312e-007
"	mrad/hr	1.038e-005	7.312e-005
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.178e-007	8.306e-007
o Opposed	"	1.022e-007	7.180e-007
o Rotational	"	1.022e-007	7.180e-007
o Isotropic	"	9.147e-008	6.421e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.249e-007	8.817e-007
o Opposed	"	1.206e-007	8.507e-007
o Rotational	"	1.206e-007	8.507e-007
o Isotropic	"	9.648e-008	6.783e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.061e-007	7.477e-007
o Posterior/Anterior	"	9.813e-008	6.902e-007
o Lateral	"	7.881e-008	5.521e-007
o Rotational	"	8.853e-008	6.223e-007
o Isotropic	"	7.869e-008	5.519e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X3SC.MS5
Run Date: March 18, 2001
Run Time: 4:07:11 PM
Duration : 00:00:19

File Ref: 004-01(MY)
Date: 3/19/01
By: [illegible]
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	2.54 cm	1.0 in
Width	360.0 cm	11 ft 9.7 in
Height	360.0 cm	11 ft 9.7 in

Dose Points

	X	Y	Z
# 1	162.54 cm	180 cm	180 cm
	5 ft 4.0 in	5 ft 10.9 in	5 ft 10.9 in

Shields

Shield Name	Dimension	Material	Density
Source	3.29e+05 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	5.3562e-007	1.9818e+004	1.6271e-006	6.0203e-002
Co-60	1.0810e-005	3.9998e+005	3.2840e-005	1.2151e+000
Cs-137	5.6620e-007	2.0949e+004	1.7200e-006	6.3640e-002
Sb-125	9.5463e-008	3.5321e+003	2.9000e-007	1.0730e-002

Buildup
The material reference is : Source

Integration Parameters

Page : 2
DOS File : 4X3SC.MS5
Run Date: March 18, 2001
Run Time: 4:07:11 PM
Duration : 00:00:19

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate $MeV/cm^2/sec$ No Buildup	Fluence Rate $MeV/cm^2/sec$ With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	2.754e+03	8.075e-39	3.592e-30	8.003e-41	3.559e-32
0.04	4.226e+02	2.991e-23	2.243e-22	1.323e-25	9.920e-25
0.1	9.220e+00	4.840e-13	3.977e-11	7.404e-16	6.085e-14
0.15	8.865e+00	6.944e-12	6.576e-10	1.143e-14	1.083e-12
0.2	2.681e+02	9.313e-10	7.601e-08	1.644e-12	1.342e-10
0.3	1.473e+01	3.455e-10	1.855e-08	6.553e-13	3.518e-11
0.4	1.106e+03	9.488e-08	3.501e-06	1.849e-10	6.822e-09
0.5	3.657e+02	8.303e-08	2.241e-06	1.630e-10	4.400e-09
0.6	1.917e+04	9.422e-06	1.977e-04	1.839e-08	3.859e-07
1.0	4.000e+05	1.539e-03	1.633e-02	2.838e-06	3.011e-05
1.5	4.000e+05	6.890e-03	4.523e-02	1.159e-05	7.609e-05
TOTALS:	8.241e+05	8.439e-03	6.176e-02	1.445e-05	1.066e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X3SC.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 4:07:11 PM
Dose Point # 1 - (162.54,180,180) cm

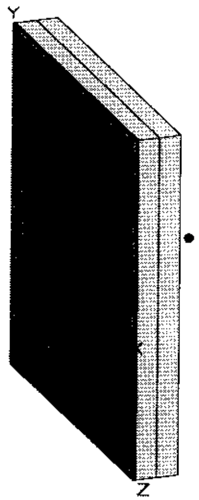
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.149e-003	4.683e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.439e-003	6.176e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.445e-005	1.066e-004
Absorbed Dose Rate in Air	mGy/hr	1.261e-007	9.306e-007
"	mrad/hr	1.261e-005	9.306e-005
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.431e-007	1.057e-006
o Opposed	"	1.241e-007	9.140e-007
o Rotational	"	1.241e-007	9.140e-007
o Isotropic	"	1.111e-007	8.175e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.517e-007	1.122e-006
o Opposed	"	1.465e-007	1.082e-006
o Rotational	"	1.465e-007	1.082e-006
o Isotropic	"	1.172e-007	8.634e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.288e-007	9.515e-007
o Posterior/Anterior	"	1.192e-007	8.785e-007
o Lateral	"	9.578e-008	7.030e-007
o Rotational	"	1.076e-007	7.921e-007
o Isotropic	"	9.562e-008	7.027e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X4SC.MS5
Run Date: March 18, 2001
Run Time: 4:09:30 PM
Duration : 00:00:19

File Ref: 004-01(MY)
Date: 3/19/01
By: [signature]
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	2.54 cm	1.0 in
Width	480.0 cm	15 ft 9.0 in
Height	480.0 cm	15 ft 9.0 in

Dose Points

	X	Y	Z
# 1	162.54 cm	240 cm	240 cm
	5 ft 4.0 in	7 ft 10.5 in	7 ft 10.5 in

Shields

Shield Name	Dimension	Material	Density
Source	5.85e+05 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	9.5222e-007	3.5232e+004	1.6271e-006	6.0203e-002
Co-60	1.9218e-005	7.1108e+005	3.2840e-005	1.2151e+000
Cs-137	1.0066e-006	3.7243e+004	1.7200e-006	6.3640e-002
Sb-125	1.6971e-007	6.2794e+003	2.9000e-007	1.0730e-002

Buildup
The material reference is : Source

Integration Parameters

Page : 2
DOS File : 4X4SC.MS5
Run Date: March 18, 2001
Run Time: 4:09:30 PM
Duration : 00:00:19

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	4.897e+03	8.070e-39	5.065e-30	7.998e-41	5.020e-32
0.04	7.513e+02	2.991e-23	2.243e-22	1.323e-25	9.920e-25
0.1	1.639e+01	4.842e-13	3.981e-11	7.407e-16	6.090e-14
0.15	1.576e+01	6.953e-12	6.596e-10	1.145e-14	1.086e-12
0.2	4.766e+02	9.335e-10	7.643e-08	1.648e-12	1.349e-10
0.3	2.619e+01	3.471e-10	1.875e-08	6.585e-13	3.556e-11
0.4	1.966e+03	9.563e-08	3.558e-06	1.863e-10	6.932e-09
0.5	6.501e+02	8.396e-08	2.290e-06	1.648e-10	4.496e-09
0.6	3.407e+04	9.562e-06	2.032e-04	1.866e-08	3.966e-07
1.0	7.111e+05	1.586e-03	1.715e-02	2.923e-06	3.161e-05
1.5	7.111e+05	7.231e-03	4.859e-02	1.217e-05	8.175e-05
TOTALS:	1.465e+06	8.827e-03	6.595e-02	1.511e-05	1.138e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X4SC.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 4:09:30 PM
Dose Point # 1 - (162.54,240,240) cm

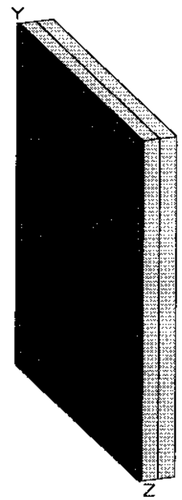
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.423e-003	4.989e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.827e-003	6.595e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.511e-005	1.138e-004
Absorbed Dose Rate in Air	mGy/hr	1.319e-007	9.932e-007
"	mrad/hr	1.319e-005	9.932e-005
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.496e-007	1.128e-006
o Opposed	"	1.298e-007	9.756e-007
o Rotational	"	1.298e-007	9.756e-007
o Isotropic	"	1.162e-007	8.726e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.586e-007	1.197e-006
o Opposed	"	1.532e-007	1.155e-006
o Rotational	"	1.532e-007	1.155e-006
o Isotropic	"	1.226e-007	9.215e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.347e-007	1.015e-006
o Posterior/Anterior	"	1.247e-007	9.377e-007
o Lateral	"	1.002e-007	7.505e-007
o Rotational	"	1.125e-007	8.455e-007
o Isotropic	"	1.000e-007	7.501e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X5SC.MS5
Run Date: March 18, 2001
Run Time: 4:11:48 PM
Duration : 00:00:19

File Ref: 004-01(MY)
Date: 3/19/01
By:
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	2.54 cm	1.0 in
Width	600.0 cm	19 ft 8.2 in
Height	600.0 cm	19 ft 8.2 in

Dose Points

	X	Y	Z
# 1	162.54 cm	300 cm	300 cm
	5 ft 4.0 in	9 ft 10.1 in	9 ft 10.1 in

Shields

Shield Name	Dimension	Material	Density
Source	9.14e+05 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	1.4878e-006	5.5050e+004	1.6271e-006	6.0203e-002
Co-60	3.0029e-005	1.1111e+006	3.2840e-005	1.2151e+000
Cs-137	1.5728e-006	5.8192e+004	1.7200e-006	6.3640e-002
Sb-125	2.6518e-007	9.8115e+003	2.9000e-007	1.0730e-002

Buildup
The material reference is : Source

Integration Parameters

Page : 2
DOS File : 4X5SC.MS5
Run Date : March 18, 2001
Run Time : 4:11:48 PM
Duration : 00:00:19

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	7.651e+03	8.101e-39	6.380e-30	8.029e-41	6.323e-32
0.04	1.174e+03	2.990e-23	2.242e-22	1.322e-25	9.916e-25
0.1	2.561e+01	4.842e-13	3.981e-11	7.407e-16	6.091e-14
0.15	2.462e+01	6.953e-12	6.597e-10	1.145e-14	1.086e-12
0.2	7.447e+02	9.336e-10	7.645e-08	1.648e-12	1.349e-10
0.3	4.092e+01	3.472e-10	1.876e-08	6.587e-13	3.559e-11
0.4	3.072e+03	9.568e-08	3.564e-06	1.864e-10	6.944e-09
0.5	1.016e+03	8.405e-08	2.297e-06	1.650e-10	4.508e-09
0.6	5.324e+04	9.577e-06	2.040e-04	1.869e-08	3.982e-07
1.0	1.111e+06	1.594e-03	1.732e-02	2.938e-06	3.193e-05
1.5	1.111e+06	7.308e-03	4.952e-02	1.230e-05	8.331e-05
TOTALS:	2.289e+06	8.912e-03	6.705e-02	1.525e-05	1.156e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X5SC.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 4:11:48 PM
Dose Point # 1 - (162.54,300,300) cm

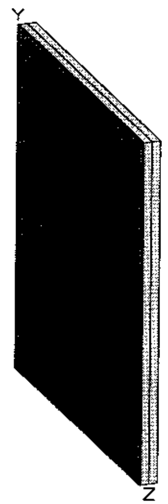
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.482e-003	5.069e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.912e-003	6.705e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.525e-005	1.156e-004
Absorbed Dose Rate in Air	mGy/hr	1.332e-007	1.010e-006
"	mrad/hr	1.332e-005	1.010e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.510e-007	1.147e-006
o Opposed	"	1.311e-007	9.917e-007
o Rotational	"	1.311e-007	9.917e-007
o Isotropic	"	1.174e-007	8.871e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.601e-007	1.217e-006
o Opposed	"	1.547e-007	1.174e-006
o Rotational	"	1.547e-007	1.174e-006
o Isotropic	"	1.238e-007	9.368e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.360e-007	1.032e-006
o Posterior/Anterior	"	1.259e-007	9.532e-007
o Lateral	"	1.011e-007	7.630e-007
o Rotational	"	1.136e-007	8.595e-007
o Isotropic	"	1.010e-007	7.626e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X10SC.MS5
Run Date : March 18, 2001
Run Time : 3:57:03 PM
Duration : 00:00:20

File Ref: 004-01 (MY)
Date: 3/19/01
By: [signature]
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	2.54 cm	1.0 in
Width	1.2e+3 cm	39 ft 4.4 in
Height	1.2e+3 cm	39 ft 4.4 in

Dose Points

	X	Y	Z
# 1	162.54 cm	600 cm	600 cm
	5 ft 4.0 in	19 ft 8.2 in	19 ft 8.2 in

Shields

Shield Name	Dimension	Material	Density
Source	3.66e+06 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	5.9514e-006	2.2020e+005	1.6271e-006	6.0203e-002
Co-60	1.2012e-004	4.4443e+006	3.2840e-005	1.2151e+000
Cs-137	6.2911e-006	2.3277e+005	1.7200e-006	6.3640e-002
Sb-125	1.0607e-006	3.9246e+004	2.9000e-007	1.0730e-002

Buildup
The material reference is : Source

Integration Parameters

Page : 2
DOS File : 4X10SC.MS5
Run Date : March 18, 2001
Run Time : 3:57:03 PM
Duration : 00:00:20

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	3.060e+04	7.551e-39	1.108e-29	7.484e-41	1.098e-31
0.04	4.695e+03	2.969e-23	2.228e-22	1.313e-25	9.853e-25
0.1	1.024e+02	4.844e-13	3.981e-11	7.411e-16	6.091e-14
0.15	9.850e+01	6.953e-12	6.595e-10	1.145e-14	1.086e-12
0.2	2.979e+03	9.334e-10	7.644e-08	1.647e-12	1.349e-10
0.3	1.637e+02	3.472e-10	1.876e-08	6.586e-13	3.559e-11
0.4	1.229e+04	9.568e-08	3.564e-06	1.864e-10	6.945e-09
0.5	4.063e+03	8.405e-08	2.297e-06	1.650e-10	4.510e-09
0.6	2.130e+05	9.578e-06	2.041e-04	1.869e-08	3.984e-07
1.0	4.444e+06	1.595e-03	1.736e-02	2.940e-06	3.200e-05
1.5	4.444e+06	7.328e-03	4.982e-02	1.233e-05	8.382e-05
TOTALS:	9.157e+06	8.933e-03	6.739e-02	1.529e-05	1.162e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X10SC.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 3:57:03 PM
Dose Point # 1 - (162.54,600,600) cm

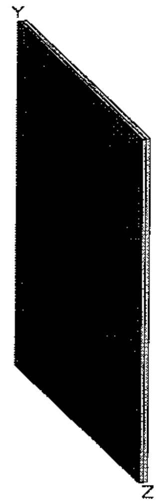
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm^2/sec	6.497e-003	5.093e-002
Photon Energy Fluence Rate	MeV/cm^2/sec	8.933e-003	6.739e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.529e-005	1.162e-004
Absorbed Dose Rate in Air	mGy/hr	1.335e-007	1.015e-006
"	mrad/hr	1.335e-005	1.015e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.514e-007	1.152e-006
o Opposed	"	1.314e-007	9.968e-007
o Rotational	"	1.314e-007	9.968e-007
o Isotropic	"	1.176e-007	8.916e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.605e-007	1.223e-006
o Opposed	"	1.550e-007	1.180e-006
o Rotational	"	1.550e-007	1.180e-006
o Isotropic	"	1.241e-007	9.416e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.363e-007	1.037e-006
o Posterior/Anterior	"	1.262e-007	9.581e-007
o Lateral	"	1.014e-007	7.669e-007
o Rotational	"	1.138e-007	8.639e-007
o Isotropic	"	1.012e-007	7.665e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X20SC.MS5
Run Date: March 18, 2001
Run Time: 4:02:40 PM
Duration : 00:00:21

File Ref: 004-01 (MY)
Date: 3/19/01
By: A
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	2.54 cm	1.0 in
Width	2.4e+3 cm	78 ft 8.9 in
Height	2.4e+3 cm	78 ft 8.9 in

Dose Points

	X	Y	Z
# 1	162.54 cm	1200 cm	1200 cm
	5 ft 4.0 in	39 ft 4.4 in	39 ft 4.4 in

Shields

Shield Name	Dimension	Material	Density
Source	1.46e+07 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.3805e-005	8.8080e+005	1.6271e-006	6.0203e-002
Co-60	4.8046e-004	1.7777e+007	3.2840e-005	1.2151e+000
Cs-137	2.5164e-005	9.3108e+005	1.7200e-006	6.3640e-002
Sb-125	4.2428e-006	1.5698e+005	2.9000e-007	1.0730e-002

Buildup
The material reference is : Source

Integration Parameters

Page : 2
DOS File : 4X20SC.MS5
Run Date: March 18, 2001
Run Time: 4:02:40 PM
Duration : 00:00:21

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate $MeV/cm^2/sec$ No Buildup	Fluence Rate $MeV/cm^2/sec$ With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	1.224e+05	1.170e-38	1.620e-29	1.160e-40	1.606e-31
0.04	1.878e+04	3.313e-23	2.475e-22	1.465e-25	1.094e-24
0.1	4.098e+02	4.660e-13	3.872e-11	7.130e-16	5.924e-14
0.15	3.940e+02	6.788e-12	6.520e-10	1.118e-14	1.074e-12
0.2	1.191e+04	9.181e-10	7.603e-08	1.620e-12	1.342e-10
0.3	6.547e+02	3.443e-10	1.875e-08	6.531e-13	3.557e-11
0.4	4.915e+04	9.528e-08	3.569e-06	1.856e-10	6.953e-09
0.5	1.625e+04	8.390e-08	2.301e-06	1.647e-10	4.518e-09
0.6	8.518e+05	9.574e-06	2.045e-04	1.869e-08	3.992e-07
1.0	1.778e+07	1.597e-03	1.739e-02	2.945e-06	3.206e-05
1.5	1.778e+07	7.340e-03	4.989e-02	1.235e-05	8.394e-05
TOTALS:	3.663e+07	8.947e-03	6.749e-02	1.531e-05	1.164e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X20SC.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 4:02:40 PM
Dose Point # 1 - (162.54,1200,1200) cm

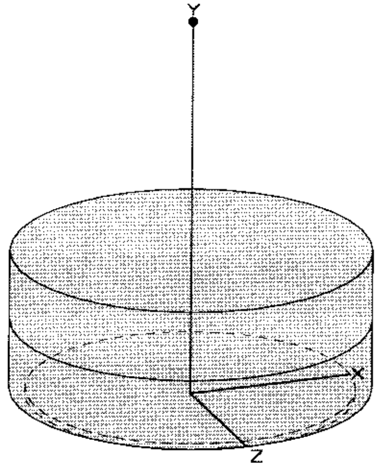
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.507e-003	5.101e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.947e-003	6.749e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.531e-005	1.164e-004
Absorbed Dose Rate in Air	mGy/hr	1.337e-007	1.016e-006
"	mrad/hr	1.337e-005	1.016e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.516e-007	1.154e-006
o Opposed	"	1.316e-007	9.983e-007
o Rotational	"	1.316e-007	9.983e-007
o Isotropic	"	1.178e-007	8.930e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.607e-007	1.225e-006
o Opposed	"	1.553e-007	1.182e-006
o Rotational	"	1.553e-007	1.182e-006
o Isotropic	"	1.243e-007	9.430e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.365e-007	1.039e-006
o Posterior/Anterior	"	1.264e-007	9.595e-007
o Lateral	"	1.015e-007	7.680e-007
o Rotational	"	1.140e-007	8.652e-007
o Isotropic	"	1.014e-007	7.676e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X1RC.MS5
Run Date : March 18, 2001
Run Time : 3:59:16 PM
Duration : 00:00:02

File Ref: 004-01(mv)
Date: 3/19/01
By:
Checked:

Case Title: Case 2
Description: Offset dose to same point from 4x1x1
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	2.54 cm	1.0 in
Radius	67.7 cm	2 ft 2.7 in

Dose Points

	X	Y	Z
# 1	0 cm	162.54 cm	0 cm
	0.0 in	5 ft 4.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	3.66e+04 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	5.9509e-008	2.2018e+003	1.6271e-006	6.0203e-002
Co-60	1.2011e-006	4.4439e+004	3.2840e-005	1.2151e+000
Cs-137	6.2906e-008	2.3275e+003	1.7200e-006	6.3640e-002
Sb-125	1.0606e-008	3.9243e+002	2.9000e-007	1.0730e-002

Buildup
The material reference is : Air Gap

Integration Parameters

Radial 20

Page : 2
DOS File : 4X1RC.MS5
Run Date: March 18, 2001
Run Time: 3:59:16 PM
Duration : 00:00:02

Circumferential 10
Y Direction (axial) 10

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	3.060e+02	8.063e-39	1.146e-29	7.991e-41	1.136e-31
0.04	4.695e+01	2.888e-23	5.471e-21	1.277e-25	2.420e-23
0.1	1.024e+00	3.385e-13	2.088e-10	5.179e-16	3.194e-13
0.15	9.849e-01	4.441e-12	1.555e-09	7.313e-15	2.561e-12
0.2	2.978e+01	5.627e-10	1.157e-07	9.931e-13	2.043e-10
0.3	1.637e+00	1.920e-10	1.741e-08	3.643e-13	3.303e-11
0.4	1.229e+02	4.944e-08	2.525e-06	9.632e-11	4.920e-09
0.5	4.063e+01	4.101e-08	1.373e-06	8.049e-11	2.696e-09
0.6	2.129e+03	4.445e-06	1.074e-04	8.677e-09	2.096e-07
1.0	4.444e+04	6.336e-04	6.809e-03	1.168e-06	1.255e-05
1.5	4.444e+04	2.533e-03	1.603e-02	4.262e-06	2.697e-05
TOTALS:	9.156e+04	3.171e-03	2.295e-02	5.438e-06	3.974e-05

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X1RC.MS5
Case Title: Case 2
This case was run on Sunday, March 18, 2001 at 3:59:16 PM
Dose Point # 1 - (0,162.54,0) cm

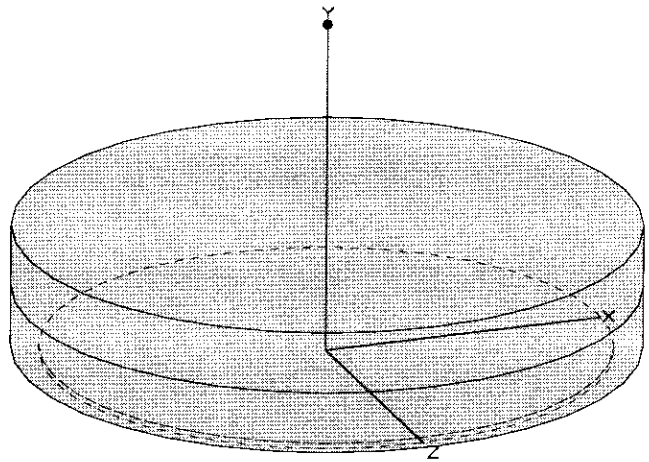
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	2.330e-003	1.769e-002
Photon Energy Fluence Rate	MeV/cm²/sec	3.171e-003	2.295e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	5.438e-006	3.974e-005
Absorbed Dose Rate in Air	mGy/hr	4.748e-008	3.470e-007
"	mrad/hr	4.748e-006	3.470e-005
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	5.386e-008	3.943e-007
o Opposed	"	4.671e-008	3.405e-007
o Rotational	"	4.671e-008	3.405e-007
o Isotropic	"	4.181e-008	3.044e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	5.712e-008	4.186e-007
o Opposed	"	5.517e-008	4.038e-007
o Rotational	"	5.517e-008	4.038e-007
o Isotropic	"	4.411e-008	3.217e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	4.851e-008	3.549e-007
o Posterior/Anterior	"	4.486e-008	3.274e-007
o Lateral	"	3.601e-008	2.615e-007
o Rotational	"	4.047e-008	2.951e-007
o Isotropic	"	3.596e-008	2.616e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X2RC.MS5
Run Date : March 18, 2001
Run Time : 4:03:55 PM
Duration : 00:00:03

File Ref: 004-01 (MY)
Date: 3/19/01
By: [illegible]
Checked:

Case Title: Case 2
Description: Offset dose to same point from 4x1x1
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	2.54 cm	1.0 in
Radius	135.0 cm	4 ft 5.1 in

Dose Points

	X	Y	Z
# 1	0 cm	162.54 cm	0 cm
	0.0 in	5 ft 4.0 in	0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.45e+05 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.3663e-007	8.7553e+003	1.6271e-006	6.0203e-002
Co-60	4.7759e-006	1.7671e+005	3.2840e-005	1.2151e+000
Cs-137	2.5014e-007	9.2551e+003	1.7200e-006	6.3640e-002
Sb-125	4.2174e-008	1.5605e+003	2.9000e-007	1.0730e-002

Buildup
The material reference is : Air Gap

Integration Parameters

Radial	20

Page : 2
DOS File : 4X2RC.MS5
Run Date: March 18, 2001
Run Time: 4:03:55 PM
Duration : 00:00:03

Circumferential	10
Y Direction (axial)	10

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	1.217e+03	8.075e-39	3.758e-29	8.003e-41	3.725e-31
0.04	1.867e+02	2.991e-23	5.692e-21	1.323e-25	2.517e-23
0.1	4.073e+00	4.776e-13	3.222e-10	7.307e-16	4.930e-13
0.15	3.916e+00	6.772e-12	2.645e-09	1.115e-14	4.356e-12
0.2	1.184e+02	8.993e-10	2.074e-07	1.587e-12	3.660e-10
0.3	6.508e+00	3.278e-10	3.321e-08	6.218e-13	6.300e-11
0.4	4.886e+02	8.858e-08	5.038e-06	1.726e-10	9.815e-09
0.5	1.616e+02	7.637e-08	2.835e-06	1.499e-10	5.565e-09
0.6	8.468e+03	8.547e-06	2.279e-04	1.668e-08	4.448e-07
1.0	1.767e+05	1.333e-03	1.563e-02	2.457e-06	2.881e-05
1.5	1.767e+05	5.709e-03	3.898e-02	9.606e-06	6.559e-05
TOTALS:	3.641e+05	7.051e-03	5.485e-02	1.208e-05	9.486e-05

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X2RC.MS5
Case Title: Case 2
This case was run on Sunday, March 18, 2001 at 4:03:55 PM
Dose Point # 1 - (0,162.54,0) cm

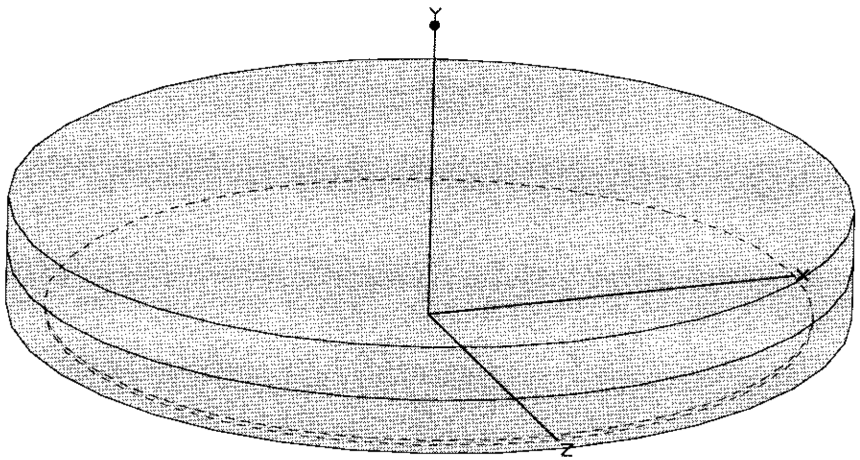
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	5.154e-003	4.202e-002
Photon Energy Fluence Rate	MeV/cm²/sec	7.051e-003	5.485e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.208e-005	9.486e-005
Absorbed Dose Rate in Air	mGy/hr	1.055e-007	8.281e-007
"	mrad/hr	1.055e-005	8.281e-005
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.196e-007	9.409e-007
o Opposed	"	1.038e-007	8.129e-007
o Rotational	"	1.038e-007	8.129e-007
o Isotropic	"	9.290e-008	7.269e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.268e-007	9.989e-007
o Opposed	"	1.225e-007	9.636e-007
o Rotational	"	1.225e-007	9.636e-007
o Isotropic	"	9.800e-008	7.680e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.077e-007	8.469e-007
o Posterior/Anterior	"	9.967e-008	7.816e-007
o Lateral	"	8.005e-008	6.248e-007
o Rotational	"	8.992e-008	7.046e-007
o Isotropic	"	7.992e-008	6.247e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X3RC.MS5
Run Date: March 18, 2001
Run Time: 4:06:16 PM
Duration : 00:00:03

File Ref: [initials]
Date: 3/19/01
By: [initials]
Checked:

Case Title: Case 2
Description: Offset dose to same point from 4x1x1
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	2.54 cm	1.0 in
Radius	203.0 cm	6 ft 7.9 in

Dose Points

	X	Y	Z
# 1	0 cm 0.0 in	162.54 cm 5 ft 4.0 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	3.29e+05 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	5.3505e-007	1.9797e+004	1.6271e-006	6.0203e-002
Co-60	1.0799e-005	3.9956e+005	3.2840e-005	1.2151e+000
Cs-137	5.6559e-007	2.0927e+004	1.7200e-006	6.3640e-002
Sb-125	9.5362e-008	3.5284e+003	2.9000e-007	1.0730e-002

Buildup
The material reference is : Air Gap

Integration Parameters

Radial	20

DOS File : 4X3RC.MS5
Run Date: March 18, 2001
Run Time: 4:06:16 PM
Duration : 00:00:03

Circumferential 10
Y Direction (axial) 10

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	2.751e+03	8.075e-39	6.706e-29	8.003e-41	6.646e-31
0.04	4.221e+02	2.991e-23	5.692e-21	1.323e-25	2.517e-23
0.1	9.210e+00	4.841e-13	3.310e-10	7.406e-16	5.063e-13
0.15	8.856e+00	6.948e-12	2.782e-09	1.144e-14	4.581e-12
0.2	2.678e+02	9.322e-10	2.218e-07	1.645e-12	3.915e-10
0.3	1.472e+01	3.461e-10	3.646e-08	6.565e-13	6.916e-11
0.4	1.105e+03	9.513e-08	5.651e-06	1.854e-10	1.101e-08
0.5	3.653e+02	8.331e-08	3.241e-06	1.635e-10	6.362e-09
0.6	1.915e+04	9.461e-06	2.649e-04	1.847e-08	5.171e-07
1.0	3.996e+05	1.550e-03	1.916e-02	2.857e-06	3.532e-05
1.5	3.996e+05	6.952e-03	5.007e-02	1.170e-05	8.424e-05
TOTALS:	8.232e+05	8.511e-03	6.951e-02	1.457e-05	1.201e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X3RC.MS5
Case Title: Case 2
This case was run on Sunday, March 18, 2001 at 4:06:16 PM
Dose Point # 1 - (0,162.54,0) cm

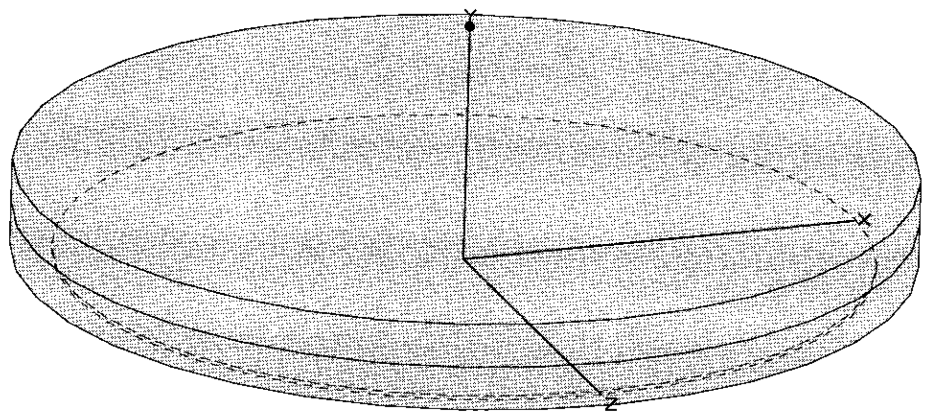
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.200e-003	5.301e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.511e-003	6.951e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.457e-005	1.201e-004
Absorbed Dose Rate in Air	mGy/hr	1.272e-007	1.048e-006
"	mrad/hr	1.272e-005	1.048e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.443e-007	1.191e-006
o Opposed	"	1.252e-007	1.029e-006
o Rotational	"	1.252e-007	1.029e-006
o Isotropic	"	1.121e-007	9.206e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.530e-007	1.264e-006
o Opposed	"	1.478e-007	1.220e-006
o Rotational	"	1.478e-007	1.220e-006
o Isotropic	"	1.182e-007	9.725e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.299e-007	1.072e-006
o Posterior/Anterior	"	1.202e-007	9.896e-007
o Lateral	"	9.660e-008	7.915e-007
o Rotational	"	1.085e-007	8.922e-007
o Isotropic	"	9.644e-008	7.912e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X4RC.MS5
Run Date : March 18, 2001
Run Time : 4:08:30 PM
Duration : 00:00:03

File Ref: 004.01(MV)
Date: 3/19/01
By: [illegible]
Checked:

Case Title: Case 2
Description: Offset dose to same point from 4x1x1
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	2.54 cm	1.0 in
Radius	271.0 cm	8 ft 10.7 in

Dose Points

	X	Y	Z
# 1	0 cm 0.0 in	162.54 cm 5 ft 4.0 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	5.86e+05 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	9.5355e-007	3.5281e+004	1.6271e-006	6.0203e-002
Co-60	1.9245e-005	7.1208e+005	3.2840e-005	1.2151e+000
Cs-137	1.0080e-006	3.7295e+004	1.7200e-006	6.3640e-002
Sb-125	1.6995e-007	6.2881e+003	2.9000e-007	1.0730e-002

Buildup
The material reference is : Air Gap

Integration Parameters

Radial 20

DOS File : 4X4RC.MS5
Run Date: March 18, 2001
Run Time: 4:08:30 PM
Duration : 00:00:03

Circumferential 10
Y Direction (axial) 10

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	4.903e+03	8.075e-39	9.458e-29	8.003e-41	9.374e-31
0.04	7.523e+02	2.991e-23	5.692e-21	1.323e-25	2.517e-23
0.1	1.641e+01	4.842e-13	3.312e-10	7.407e-16	5.067e-13
0.15	1.578e+01	6.953e-12	2.789e-09	1.145e-14	4.592e-12
0.2	4.773e+02	9.335e-10	2.228e-07	1.648e-12	3.932e-10
0.3	2.623e+01	3.472e-10	3.678e-08	6.586e-13	6.976e-11
0.4	1.969e+03	9.566e-08	5.726e-06	1.864e-10	1.116e-08
0.5	6.510e+02	8.401e-08	3.301e-06	1.649e-10	6.479e-09
0.6	3.412e+04	9.568e-06	2.712e-04	1.868e-08	5.293e-07
1.0	7.121e+05	1.589e-03	2.001e-02	2.929e-06	3.688e-05
1.5	7.121e+05	7.255e-03	5.347e-02	1.221e-05	8.997e-05
TOTALS:	1.467e+06	8.853e-03	7.376e-02	1.515e-05	1.274e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X4RC.MS5
Case Title: Case 2
This case was run on Sunday, March 18, 2001 at 4:08:30 PM
Dose Point # 1 - (0,162.54,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.442e-003	5.613e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.853e-003	7.376e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.515e-005	1.274e-004
Absorbed Dose Rate in Air	mGy/hr	1.323e-007	1.112e-006
"	mrad/hr	1.323e-005	1.112e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.500e-007	1.263e-006
o Opposed	"	1.302e-007	1.092e-006
o Rotational	"	1.302e-007	1.092e-006
o Isotropic	"	1.166e-007	9.768e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.591e-007	1.341e-006
o Opposed	"	1.537e-007	1.294e-006
o Rotational	"	1.537e-007	1.294e-006
o Isotropic	"	1.230e-007	1.032e-006
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.351e-007	1.137e-006
o Posterior/Anterior	"	1.250e-007	1.050e-006
o Lateral	"	1.005e-007	8.398e-007
o Rotational	"	1.128e-007	9.466e-007
o Isotropic	"	1.003e-007	8.395e-007

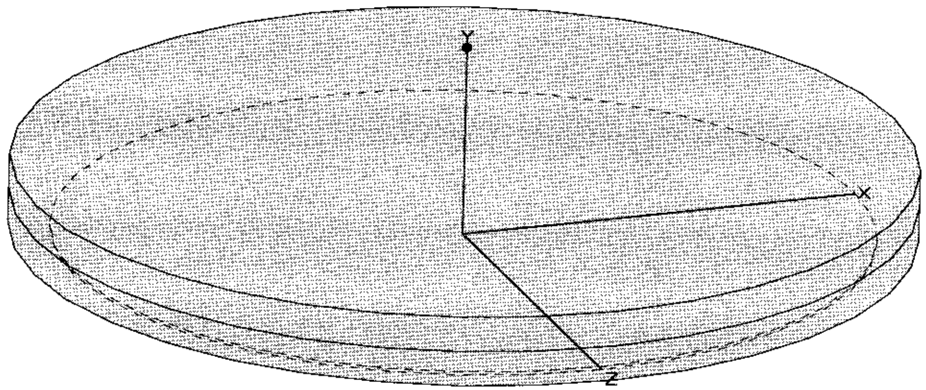
Attachment 6-16
Page 46 of 65

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X5RC.MS5
Run Date : March 18, 2001
Run Time : 4:10:43 PM
Duration : 00:00:03

File Ref: 004-01 (MY)
Date: 3/19/01
By:
Checked:

Case Title: Case 2
Description: Offset dose to same point from 4x1x1
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	2.54 cm	1.0 in
Radius	338.0 cm	11 ft 1.1 in

Dose Points

	X	Y	Z
# 1	0 cm 0.0 in	162.54 cm 5 ft 4.0 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	9.12e+05 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	1.4833e-006	5.4883e+004	1.6271e-006	6.0203e-002
Co-60	2.9938e-005	1.1077e+006	3.2840e-005	1.2151e+000
Cs-137	1.5680e-006	5.8016e+004	1.7200e-006	6.3640e-002
Sb-125	2.6437e-007	9.7818e+003	2.9000e-007	1.0730e-002

Buildup
The material reference is : Air Gap

Integration Parameters

Radial	20

Page : 2
DOS File : 4X5RC.MS5
Run Date: March 18, 2001
Run Time: 4:10:43 PM
Duration : 00:00:03

Circumferential 10
Y Direction (axial) 10

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	7.628e+03	8.077e-39	1.187e-28	8.005e-41	1.176e-30
0.04	1.170e+03	2.991e-23	5.692e-21	1.323e-25	2.517e-23
0.1	2.553e+01	4.842e-13	3.312e-10	7.407e-16	5.067e-13
0.15	2.455e+01	6.953e-12	2.789e-09	1.145e-14	4.593e-12
0.2	7.424e+02	9.336e-10	2.228e-07	1.648e-12	3.933e-10
0.3	4.080e+01	3.472e-10	3.680e-08	6.587e-13	6.980e-11
0.4	3.063e+03	9.569e-08	5.733e-06	1.864e-10	1.117e-08
0.5	1.013e+03	8.406e-08	3.307e-06	1.650e-10	6.491e-09
0.6	5.308e+04	9.578e-06	2.719e-04	1.869e-08	5.308e-07
1.0	1.108e+06	1.594e-03	2.017e-02	2.939e-06	3.717e-05
1.5	1.108e+06	7.315e-03	5.432e-02	1.231e-05	9.139e-05
TOTALS:	2.282e+06	8.919e-03	7.477e-02	1.526e-05	1.291e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X5RC.MS5
Case Title: Case 2
This case was run on Sunday, March 18, 2001 at 4:10:43 PM
Dose Point # 1 - (0,162.54,0) cm

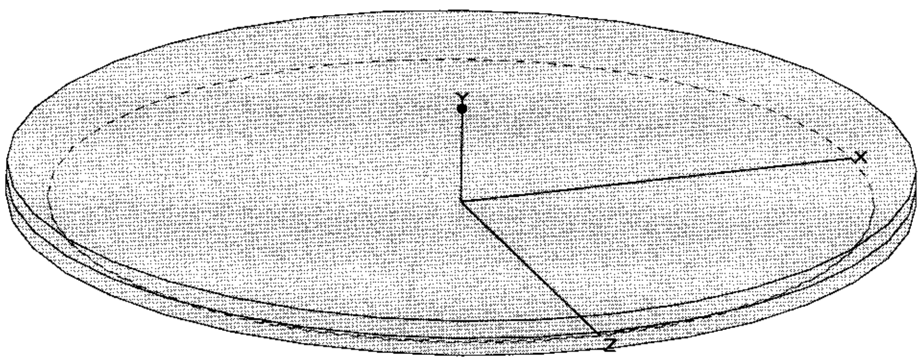
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.487e-003	5.685e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.919e-003	7.477e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.526e-005	1.291e-004
Absorbed Dose Rate in Air	mGy/hr	1.333e-007	1.127e-006
"	mrad/hr	1.333e-005	1.127e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.511e-007	1.280e-006
o Opposed	"	1.312e-007	1.107e-006
o Rotational	"	1.312e-007	1.107e-006
o Isotropic	"	1.174e-007	9.899e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.602e-007	1.359e-006
o Opposed	"	1.548e-007	1.311e-006
o Rotational	"	1.548e-007	1.311e-006
o Isotropic	"	1.239e-007	1.046e-006
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.361e-007	1.152e-006
o Posterior/Anterior	"	1.260e-007	1.064e-006
o Lateral	"	1.012e-007	8.512e-007
o Rotational	"	1.137e-007	9.593e-007
o Isotropic	"	1.010e-007	8.509e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X10RC.MS5
Run Date: March 18, 2001
Run Time: 3:55:22 PM
Duration : 00:00:02

File Ref: 004.01 (MY)
Date: 3/19/01
By: [signature]
Checked:

Case Title: Case 2
Description: Offset dose to same point from 4x1x1
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	2.54 cm	1.0 in
Radius	677.0 cm	22 ft 2.5 in

Dose Points

	X	Y	Z
# 1	0 cm 0.0 in	162.54 cm 5 ft 4.0 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	3.66e+06 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	5.9509e-006	2.2018e+005	1.6271e-006	6.0203e-002
Co-60	1.2011e-004	4.4439e+006	3.2840e-005	1.2151e+000
Cs-137	6.2906e-006	2.3275e+005	1.7200e-006	6.3640e-002
Sb-125	1.0606e-006	3.9243e+004	2.9000e-007	1.0730e-002

Buildup
The material reference is : Air Gap

Integration Parameters

Radial	20

Page : 2
DOS File : 4X10RC.MS5
Run Date: March 18, 2001
Run Time: 3:55:22 PM
Duration : 00:00:02

Circumferential 10
Y Direction (axial) 10

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	3.060e+04	8.077e-39	2.055e-28	8.005e-41	2.036e-30
0.04	4.695e+03	2.991e-23	5.691e-21	1.323e-25	2.517e-23
0.1	1.024e+02	4.842e-13	3.312e-10	7.407e-16	5.067e-13
0.15	9.849e+01	6.953e-12	2.789e-09	1.145e-14	4.593e-12
0.2	2.978e+03	9.336e-10	2.228e-07	1.648e-12	3.933e-10
0.3	1.637e+02	3.472e-10	3.680e-08	6.587e-13	6.980e-11
0.4	1.229e+04	9.569e-08	5.734e-06	1.864e-10	1.117e-08
0.5	4.063e+03	8.406e-08	3.308e-06	1.650e-10	6.493e-09
0.6	2.129e+05	9.579e-06	2.720e-04	1.870e-08	5.310e-07
1.0	4.444e+06	1.595e-03	2.020e-02	2.940e-06	3.723e-05
1.5	4.444e+06	7.328e-03	5.456e-02	1.233e-05	9.180e-05
TOTALS:	9.156e+06	8.933e-03	7.504e-02	1.529e-05	1.296e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X10RC.MS5
Case Title: Case 2
This case was run on Sunday, March 18, 2001 at 3:55:22 PM
Dose Point # 1 - (0,162.54,0) cm

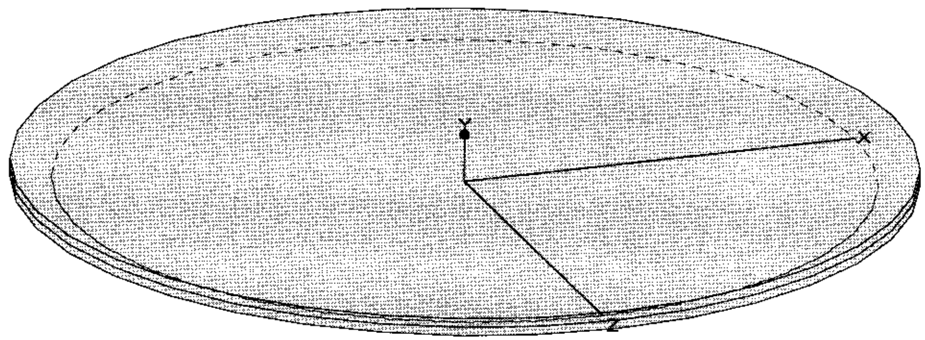
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.497e-003	5.705e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.933e-003	7.504e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.529e-005	1.296e-004
Absorbed Dose Rate in Air	mGy/hr	1.335e-007	1.131e-006
"	mrad/hr	1.335e-005	1.131e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.514e-007	1.285e-006
o Opposed	"	1.314e-007	1.111e-006
o Rotational	"	1.314e-007	1.111e-006
o Isotropic	"	1.176e-007	9.935e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.605e-007	1.364e-006
o Opposed	"	1.550e-007	1.316e-006
o Rotational	"	1.550e-007	1.316e-006
o Isotropic	"	1.241e-007	1.049e-006
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.363e-007	1.157e-006
o Posterior/Anterior	"	1.262e-007	1.068e-006
o Lateral	"	1.014e-007	8.543e-007
o Rotational	"	1.138e-007	9.628e-007
o Isotropic	"	1.012e-007	8.539e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : 4X20RC.MS5
Run Date: March 18, 2001
Run Time: 4:01:38 PM
Duration : 00:00:03

File Ref: 004.01(my)
Date: 3/19/01
By:
Checked:

Case Title: Case 2
Description: Offset dose to same point from 4x1x1
Geometry: 8 - Cylinder Volume - End Shields



Source Dimensions

Height	2.54 cm	1.0 in
Radius	1.4e+3 cm	44 ft 5.1 in

Dose Points

	X	Y	Z
# 1	0 cm 0.0 in	162.54 cm 5 ft 4.0 in	0 cm 0.0 in

Shields

Shield Name	Dimension	Material	Density
Source	1.46e+07 cm³	SiO2	1.6
Shield 1	30.0 cm	SiO2	2.6
Shield 2	30.0 cm	Air	0.00122
Air Gap		Air	0.00122

Source Input
Grouping Method : Standard Indices
Number of Groups : 25
Lower Energy Cutoff : 0.015
Photons < 0.015 : Excluded
Library : Grove

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.3803e-005	8.8073e+005	1.6271e-006	6.0203e-002
Co-60	4.8042e-004	1.7776e+007	3.2840e-005	1.2151e+000
Cs-137	2.5162e-005	9.3100e+005	1.7200e-006	6.3640e-002
Sb-125	4.2425e-006	1.5697e+005	2.9000e-007	1.0730e-002

Buildup
The material reference is : Air Gap

Integration Parameters

Radial 20

Page : 2
DOS File : 4X20RC.MS5
Run Date: March 18, 2001
Run Time: 4:01:38 PM
Duration : 00:00:03

Circumferential 10
Y Direction (axial) 10

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.03	1.224e+05	8.066e-39	2.996e-28	7.994e-41	2.969e-30
0.04	1.878e+04	2.991e-23	5.691e-21	1.323e-25	2.517e-23
0.1	4.098e+02	4.842e-13	3.312e-10	7.407e-16	5.067e-13
0.15	3.940e+02	6.953e-12	2.789e-09	1.145e-14	4.593e-12
0.2	1.191e+04	9.336e-10	2.228e-07	1.648e-12	3.933e-10
0.3	6.547e+02	3.472e-10	3.680e-08	6.587e-13	6.980e-11
0.4	4.915e+04	9.569e-08	5.734e-06	1.864e-10	1.117e-08
0.5	1.625e+04	8.406e-08	3.308e-06	1.650e-10	6.493e-09
0.6	8.518e+05	9.579e-06	2.720e-04	1.870e-08	5.310e-07
1.0	1.778e+07	1.595e-03	2.020e-02	2.940e-06	3.723e-05
1.5	1.778e+07	7.328e-03	5.457e-02	1.233e-05	9.181e-05
TOTALS:	3.662e+07	8.933e-03	7.505e-02	1.529e-05	1.296e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: A:\4X20RC.MS5
Case Title: Case 2
This case was run on Sunday, March 18, 2001 at 4:01:38 PM
Dose Point # 1 - (0,162.54,0) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.497e-003	5.705e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.933e-003	7.505e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.529e-005	1.296e-004
Absorbed Dose Rate in Air	mGy/hr	1.335e-007	1.131e-006
"	mrad/hr	1.335e-005	1.131e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.514e-007	1.285e-006
o Opposed	"	1.314e-007	1.111e-006
o Rotational	"	1.314e-007	1.111e-006
o Isotropic	"	1.176e-007	9.936e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.605e-007	1.364e-006
o Opposed	"	1.550e-007	1.316e-006
o Rotational	"	1.550e-007	1.316e-006
o Isotropic	"	1.241e-007	1.049e-006
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.363e-007	1.157e-006
o Posterior/Anterior	"	1.262e-007	1.068e-006
o Lateral	"	1.014e-007	8.544e-007
o Rotational	"	1.138e-007	9.629e-007
o Isotropic	"	1.012e-007	8.540e-007

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : FBRFCS.MS5
Run Date : March 18, 2001
Run Time : 4:48:19 PM
Duration : 00:00:09

File Ref: 004-01 (MY)
Date: 3/19/01
By:
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	15.0 cm	5.9 in
Width	1.0e+4 cm	328 ft 1.0 in
Height	1.0e+4 cm	328 ft 1.0 in

Dose Points

	X	Y	Z
# 1	115 cm 3 ft 9.3 in	5000 cm 164 ft 0.5 in	5000 cm 164 ft 0.5 in

Shields

Shield Name	Dimension	Material	Density
Source	1.50e+09 cm³	SiO2	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Ba-137m	2.2704e-003	8.4005e+007	1.5136e-006	5.6003e-002
Cs-137	2.4000e-003	8.8800e+007	1.6000e-006	5.9200e-002

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Page : 2
DOS File : FBRFCS.MS5
Run Date: March 18, 2001
Run Time: 4:48:19 PM
Duration : 00:00:09

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.0318	1.739e+06	1.288e-05	1.765e-05	1.073e-07	1.470e-07
0.0322	3.209e+06	2.485e-05	3.429e-05	2.000e-07	2.760e-07
0.0364	1.168e+06	1.413e-05	2.132e-05	8.030e-08	1.211e-07
0.6616	7.559e+07	1.338e-01	2.878e-01	2.593e-04	5.580e-04
TOTALS:	8.170e+07	1.338e-01	2.879e-01	2.597e-04	5.585e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\FBRFCS.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 4:48:19 PM
Dose Point # 1 - (115,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	2.037e-001	4.372e-001
Photon Energy Fluence Rate	MeV/cm²/sec	1.338e-001	2.879e-001
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	2.597e-004	5.585e-004
Absorbed Dose Rate in Air	mGy/hr	2.267e-006	4.876e-006
"	mrad/hr	2.267e-004	4.876e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.684e-006	5.773e-006
o Opposed	"	2.148e-006	4.620e-006
o Rotational	"	2.148e-006	4.620e-006
o Isotropic	"	1.899e-006	4.085e-006
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	2.853e-006	6.136e-006
o Opposed	"	2.709e-006	5.826e-006
o Rotational	"	2.709e-006	5.826e-006
o Isotropic	"	2.031e-006	4.368e-006
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	2.372e-006	5.102e-006
o Posterior/Anterior	"	2.093e-006	4.503e-006
o Lateral	"	1.552e-006	3.339e-006
o Rotational	"	1.870e-006	4.024e-006
o Isotropic	"	1.592e-006	3.425e-006

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : FBRFCO.MS5
Run Date : March 18, 2001
Run Time : 4:47:17 PM
Duration : 00:00:07

File Ref: 004-01 (MY)
Date: 3/18/01
By:
Checked:

Case Title: Case 1
Description: Case 1
Geometry: 13 - Rectangular Volume

Source Dimensions

Length	15.0 cm	5.9 in
Width	1.0e+4 cm	328 ft 1.0 in
Height	1.0e+4 cm	328 ft 1.0 in

Dose Points

	X	Y	Z
# 1	115 cm 3 ft 9.3 in	5000 cm 164 ft 0.5 in	5000 cm 164 ft 0.5 in

Shields

Shield Name	Dimension	Material	Density
Source	1.50e+09 cm³	SiO2	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Co-60	2.4000e-003	8.8800e+007	1.6000e-006	5.9200e-002

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	1.449e+04	2.739e-05	5.803e-05	5.288e-08	1.120e-07

Page : 2
DOS File : FBRFCO.MS5
Run Date : March 18, 2001
Run Time : 4:47:17 PM
Duration : 00:00:07

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
1.1732	8.880e+07	3.512e-01	6.342e-01	6.276e-04	1.133e-03
1.3325	8.880e+07	4.202e-01	7.331e-01	7.290e-04	1.272e-03
TOTALS:	1.776e+08	7.714e-01	1.367e+00	1.357e-03	2.405e-03

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\FBRFCO.MS5
Case Title: Case 1
This case was run on Sunday, March 18, 2001 at 4:47:17 PM
Dose Point # 1 - (115,5000,5000) cm

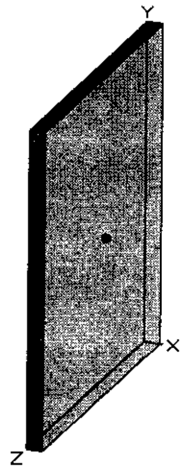
Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	6.147e-001	1.091e+000
Photon Energy Fluence Rate	MeV/cm²/sec	7.714e-001	1.367e+000
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.357e-003	2.405e-003
Absorbed Dose Rate in Air	mGy/hr	1.184e-005	2.100e-005
"	mrad/hr	1.184e-003	2.100e-003
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.345e-005	2.385e-005
o Opposed	"	1.157e-005	2.052e-005
o Rotational	"	1.157e-005	2.052e-005
o Isotropic	"	1.034e-005	1.832e-005
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.432e-005	2.539e-005
o Opposed	"	1.379e-005	2.444e-005
o Rotational	"	1.379e-005	2.444e-005
o Isotropic	"	1.095e-005	1.942e-005
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.211e-005	2.147e-005
o Posterior/Anterior	"	1.115e-005	1.977e-005
o Lateral	"	8.859e-006	1.570e-005
o Rotational	"	1.004e-005	1.780e-005
o Isotropic	"	8.880e-006	1.574e-005

MicroShield v5.05 (5.05-00201)
Maine Yankee

Page : 1
DOS File : DEEPSL.MS5
Run Date : March 16, 2001
Run Time : 4:26:00 PM
Duration : 00:00:08

File Ref:
Date:
By:
Checked:

Case Title: Deep Soil
Description: Direct Dose Rate for Unit Activity
Geometry: 13 - Rectangular Volume



Source Dimensions

Length	485.0 cm	15 ft 10.9 in
Width	1.0e+4 cm	328 ft 1.0 in
Height	1.0e+4 cm	328 ft 1.0 in

Dose Points

	X	Y	Z
# 1	600 cm	5000 cm	5000 cm
	19 ft 8.2 in	164 ft 0.5 in	164 ft 0.5 in

Shields

Shield Name	Dimension	Material	Density
Source	4.85e+10 cm³	SiO2	1.6
Shield 1	15.0 cm	SiO2	1.6
Air Gap		Air	0.00122

Source Input
Grouping Method : Actual Photon Energies

Nuclide	curies	becquerels	μCi/cm³	Bq/cm³
Co-60	7.7600e-002	2.8712e+009	1.6000e-006	5.9200e-002

Buildup
The material reference is : Source

Integration Parameters

X Direction	10
Y Direction	20
Z Direction	20

Results

Page : 2
DOS File : DEEPSL.MS5
Run Date: March 16, 2001
Run Time: 4:26:00 PM
Duration : 00:00:08

Energy MeV	Activity photons/sec	Fluence Rate MeV/cm²/sec No Buildup	Fluence Rate MeV/cm²/sec With Buildup	Exposure Rate mR/hr No Buildup	Exposure Rate mR/hr With Buildup
0.6938	4.684e+05	1.700e-06	1.179e-05	3.282e-09	2.276e-08
1.1732	2.871e+09	3.889e-02	1.728e-01	6.950e-05	3.088e-04
1.3325	2.871e+09	5.301e-02	2.144e-01	9.198e-05	3.720e-04
TOTALS:	5.743e+09	9.191e-02	3.873e-01	1.615e-04	6.809e-04

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\DEEPSL.MS5
Case Title: Deep Soil
This case was run on Friday, March 16, 2001 at 4:26:00 PM
Dose Point # 1 - (600,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	7.294e-002	3.082e-001
Photon Energy Fluence Rate	MeV/cm²/sec	9.191e-002	3.873e-001
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.615e-004	6.809e-004
Absorbed Dose Rate in Air	mGy/hr	1.410e-006	5.944e-006
"	mrad/hr	1.410e-004	5.944e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.601e-006	6.750e-006
o Opposed	"	1.378e-006	5.809e-006
o Rotational	"	1.378e-006	5.809e-006
o Isotropic	"	1.231e-006	5.188e-006
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.704e-006	7.187e-006
o Opposed	"	1.641e-006	6.918e-006
o Rotational	"	1.641e-006	6.918e-006
o Isotropic	"	1.304e-006	5.498e-006
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.441e-006	6.078e-006
o Posterior/Anterior	"	1.327e-006	5.596e-006
o Lateral	"	1.055e-006	4.447e-006
o Rotational	"	1.195e-006	5.038e-006
o Isotropic	"	1.057e-006	4.457e-006

Co-60

MicroShield v5.05 (5.05-00201)
Maine Yankee
Conversion of calculated exposure in air to dose
FILE: C:\MS5\DATA\DEEPSL.MS5
Case Title: Deep Soil
This case was run on Friday, March 16, 2001 at 4:27:15 PM
Dose Point # 1 - (600,5000,5000) cm

Results (Summed over energies)	Units	Without Buildup	With Buildup
Photon Fluence Rate (flux)	Photons/cm²/sec	1.255e-002	9.091e-002
Photon Energy Fluence Rate	MeV/cm²/sec	8.302e-003	6.015e-002
Exposure and Dose Rates:			
Exposure Rate in Air	mR/hr	1.610e-005	1.166e-004
Absorbed Dose Rate in Air	mGy/hr	1.405e-007	1.018e-006
"	mrad/hr	1.405e-005	1.018e-004
Deep Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.664e-007	1.205e-006
o Opposed	"	1.332e-007	9.650e-007
o Rotational	"	1.332e-007	9.650e-007
o Isotropic	"	1.178e-007	8.534e-007
Shallow Dose Equivalent Rate	(ICRP 51 - 1987)		
o Parallel Geometry	mSv/hr	1.768e-007	1.281e-006
o Opposed	"	1.679e-007	1.217e-006
o Rotational	"	1.679e-007	1.217e-006
o Isotropic	"	1.259e-007	9.123e-007
Effective Dose Equivalent Rate	(ICRP 51 - 1987)		
o Anterior/Posterior Geometry	mSv/hr	1.471e-007	1.066e-006
o Posterior/Anterior	"	1.298e-007	9.407e-007
o Lateral	"	9.628e-008	6.976e-007
o Rotational	"	1.160e-007	8.407e-007
o Isotropic	"	9.878e-008	7.157e-007

Cs-137

Attachment 6-17
Unitized Dose Factors for Activated Rebar

Attachment 6-17

Activated Rebar

Key Parameters:

Porosity	0.30		Concrete Density	2.20	g/cm^3
Bulk Density	1.50	g/cm^3	Annual Total Well Water Vol	738.0	m^3
Yearly Drinking Water	478.0	L/yr	Irrigation Rate	0.274	L/m^2-d
Wall Surface Area	4182.0	m^2	Surface Soil Depth	0.15	m
Fill Volume	2460.0	m^3	Activated Rebar Total Inventory	3.43E+08	Total pCi per pCi/g
Surface Area/Open Volume	1.70	m^2/m^3	Activated Rebar Total Conc.*	1.90	pCi/g
Concrete Volume	4.18	m^3	* Using Rebar radionuclides and concentration		

DOSE CALCULATION FACTORS				SOURCE TERM			Kd		WATER, FILL, REBAR CONCENTRATION				ACTIVATED REBAR ANNUAL DOSE				
Nuclide	NUREG-1727 mrem/y per pCi/g	FGR 11 mrem/pCi	Microshield mrem/y per pCi/g	Nuclide Fraction	Inventory pCi/g	Inventory pCi	Kd Fill cm^3/gm	Kd Concrete cm^3/gm	Adsorption Factor	Water pCi/L	Fill pCi/g	Concrete pCi/g	Nuclide	Drinking Water Dose mrem/y	Irrigation Dose mrem/y	Direct Dose mrem/y	Total Dose mrem/y
Cs-134	4.39E+00	7.33E-05	6.09E-05	0.00E+00	0.00E+00	0.00E+00	5.60E+01	3.00E+00	2.81E+02	0.00E+00	0.00E+00	0.00E+00	Cs-134	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Co-60	6.58E+00	2.69E-05	6.30E-04	8.40E-02	1.60E-01	5.47E+07	1.30E+01	1.00E+02	6.71E+01	1.10E+00	1.43E-02	1.10E-01	Co-60	1.42E-02	3.23E-03	9.03E-06	1.74E-02
C-14	2.08E+00	2.09E-06	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.00E+00	1.00E+02	2.72E+01	0.00E+00	0.00E+00	0.00E+00	C-14	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-154	3.13E+00	9.55E-06	3.10E-04	0.00E+00	0.00E+00	0.00E+00	4.00E+02	0.00E+00	2.00E+03	0.00E+00	0.00E+00	0.00E+00	Eu-154	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Fe-55	2.50E-03	6.07E-07	0.00E+00	9.10E-01	1.73E+00	5.93E+08	2.50E+01	1.00E+02	1.27E+02	6.32E+00	1.58E-01	6.32E-01	Fe-55	1.83E-03	7.02E-06	0.00E+00	1.84E-03
H-3	2.27E-01	6.40E-08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.00E+00	0.00E+00	0.00E+00	0.00E+00	H-3	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-152	2.87E+00	6.48E-06	2.09E-04	0.00E+00	0.00E+00	0.00E+00	4.00E+02	0.00E+00	2.00E+03	0.00E+00	0.00E+00	0.00E+00	Eu-152	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Ni-63	1.19E-02	5.77E-07	0.00E+00	6.00E-03	1.14E-02	3.91E+06	1.20E+01	1.00E+02	6.21E+01	8.51E-02	1.02E-03	8.51E-03	Ni-63	2.35E-05	4.50E-07	0.00E+00	2.39E-05
													SUM	1.60E-02	3.23E-03	9.03E-06	1.93E-02

Attachment 6-18
NRC Screening Levels for Contaminated Basement and Annulus Trench Surfaces

Attachment 6-18A

NRC Screening Levels Contaminated Basement Surfaces (Excluding Annulus Trench)				
Nuclide	**Nuclide Fraction (n*f*)**	**Screening Level dpm/100 cm^2**	**Beta Fraction**	**n*f*/Screening Level**
H-3	2.36E-02	1.24E+08		1.90E-10
Fe-55	4.81E-03	4.50E+06		1.07E-09
Co-57	3.06E-04	2.11E+05		1.45E-09
Co-60	5.84E-02	7.05E+03	5.84E-02	8.29E-06
Ni-63	3.55E-01	1.82E+06		1.95E-07
Sr-90	2.80E-03	8.71E+03	2.80E-03	3.22E-07
Cs-134	4.55E-03	1.27E+04	4.55E-03	3.58E-07
Cs-137	5.50E-01	2.80E+04	5.50E-01	1.97E-05
		Sum	6.16E-01	2.88E-05
				2.14E+04 (gross beta in dpm/100 cm^2)

Attachment 6-18B

NRC Screening Levels Annulus Trench Surfaces				
Nuclide	**Nuclide Fraction (nf)**	**Screening Level dpm/100 cm²**	**Beta Fraction**	**nf/Screening Level**
H-3	5.04E-03	1.24E+08		4.06E-11
Fe-55	1.89E-03	4.50E+06		4.21E-08
Mn-54	4.32E-04	3.15E+04		1.37E-08
Co-57	4.80E-04	2.11E+05		2.27E-09
Co-60	5.64E-01	7.05E+03	5.64E-01	8.00E-05
Ni-63	5.17E-02	1.82E+06		2.84E-08
Sr-90	3.51E-03	8.71E+03	3.51E-03	4.03E-07
Sb-125	3.15E-03	4.43E+04	3.15E-03	7.10E-08
Cs-134	1.77E-03	1.27E+04	1.77E-03	1.40E-07
Cs-137	3.66E-01	2.80E+04	3.66E-01	1.31E-05
Pu-238	3.88E-05	3.06E+01		1.27E-06
Pu-239	2.07E-05	2.79E+01		7.43E-07
Pu-240	2.07E-05	2.79E+01		7.43E-06
Pu-241	1.56E-03	1.42E+03		1.10E-06
Am-241	9.98E-06	2.70E+01		3.70E-07
Cm-243	7.45E-07	3.94E+01		1.89E-08
Cm-244	7.45E-07	4.92E+01		1.45E-08
		Sum	9.388E-01	9.80E-05
				9.59E+03 (gross beta in dpm/100 cm²)