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REMOVAL SITE EVALUATION REPLACE WOODEN SIDEWALKS AT TRAILER COMPLEXES
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REMOVAL SITE EVALUATION

REPLACE WOODEN SIDEWALKS
AT TRAILER COMPLEXES

Feed Materials Production Center

U.S. Department of Energy

March 12, 1991

There are a total of four surface sample points identified in Figure 1, the Southeast Trailer Complex. Total uranium, assumed to be represented by a natural isotopic activity distribution, characterizes the only radionuclide of concern. The average concentration represented by the four measurements was determined to be:

57 parts per million = Average Concentration at Southeast Trailer Complex.

Assuming a natural isotopic activity distribution would correspond to the following activities:

Total Uranium ~ 40 pCi/g

U-238 = 19.5 pCi/g

U-235 = 0.9 pCi/g

U-234 = 19.5 pCi/g

There are four sample points identified in Figure 2, the Trailer Complex South of the Lab Building. The samples identified in Figure 2 range in concentration from 65 (parts per million) ppm to 185 ppm with three being between 65 ppm and 80 ppm. An average surface soil concentration was found to be 100 ppm. The 100 ppm value, although probably not a completely realistic source average, will be utilized since it represents a conservative estimate. Activities, based on a natural isotopic activity distribution, would correspond as follows to the mass ratios which were in units of ppm.

Total Uranium = 66.7 pCi/g

Uranium-238 = 32.5 pCi/g

Uranium-235 = 1.5 pCi/g

Uranium-234 = 32.5 pCi/g

Although a natural isotopic activity distribution was assumed for the uranium isotopes, the uranium contamination is assumed to be NORMAL in content, meaning that the uranium has been processed and the only daughters which are included in the dose and risk calculations are the immediate, short-lived daughters, which are thorium-234 and protactinium-234.

EVALUATION OF THE MAGNITUDE OF THE POTENTIAL THREAT

Eight surface and subsurface samples were analyzed at the FMPC laboratory for Total Uranium and Total Thorium. Eight surface samples were analyzed at TCT - St. Louis Laboratory for TCLP analysis. A summary of the soil sampling results from Tables 1 and 2 are listed below.

Doses and Risks were estimated for two exposure scenarios over two locations. The two source locations were the Southeast Trailer Complex and the Trailer Complex South of the Lab Building, see Figures (1) and (2). Exposure scenario number (1) was identified as an external radiation pathway which occurs as the receptor, an RME individual for this pathway, walks past the contaminated areas each day. Exposure scenario number (2) was identified by the worker who dismantles the existing sidewalks and excavates the ground in preparation for the installation of the concrete sidewalks.

The total risks for exposure scenario number (1) are shown below:

Southeast Trailer Complex
Total Risk = 1.9×10^{-8}

Trailer Complex South of Lab Building
Total Risk = 3.1×10^{-7}

Similarly, the total risks for exposure scenario (2) are shown below:

Southeast Trailer Complex
Total Risk = 6.2×10^{-8}

Trailer Complex South of Lab Building
Total Risk = 1.2×10^{-7}

Even considering the above assumptions, the doses estimated in this assessment can be considered insignificant since natural sources have been estimated by the NCRP to deliver a dose of approximately 300 millirem per year (NCRP, 1987). Manmade sources deliver a dose of approximately 70 millirem per year. The EPA and NRC have proposed BRC (Below Regulatory Concern) dose levels of between 4 to 10 mrem per year, committed effective dose equivalent, for an individual and 1 mrem per year for population exposures. As a result, the risks estimated are in the range of proposed "diminis levels" (Travis, 1989).

ASSESSMENT OF THE NEED FOR REMOVAL ACTION

Consistent with Section 40 CFR 300.410 of the NCP, the Department of Energy shall determine the appropriateness of a removal action. Eight factors to be considered in this determination are listed in 40 CFR300.415 (b) (2) of the National Contingency Plan. Three of these factors are listed below.

1. Actual or potential exposure to hazardous substances or pollutants or contaminants to nearby populations, animals, or food chain.

2. High levels of hazardous waste constituents, pollutants, or contaminants in soils largely at or near the surface, that may migrate.

REMOVAL SITE EVALUATION
REPLACEMENT OF WOODEN SIDEWALKS AT TRAILER COMPLEXES

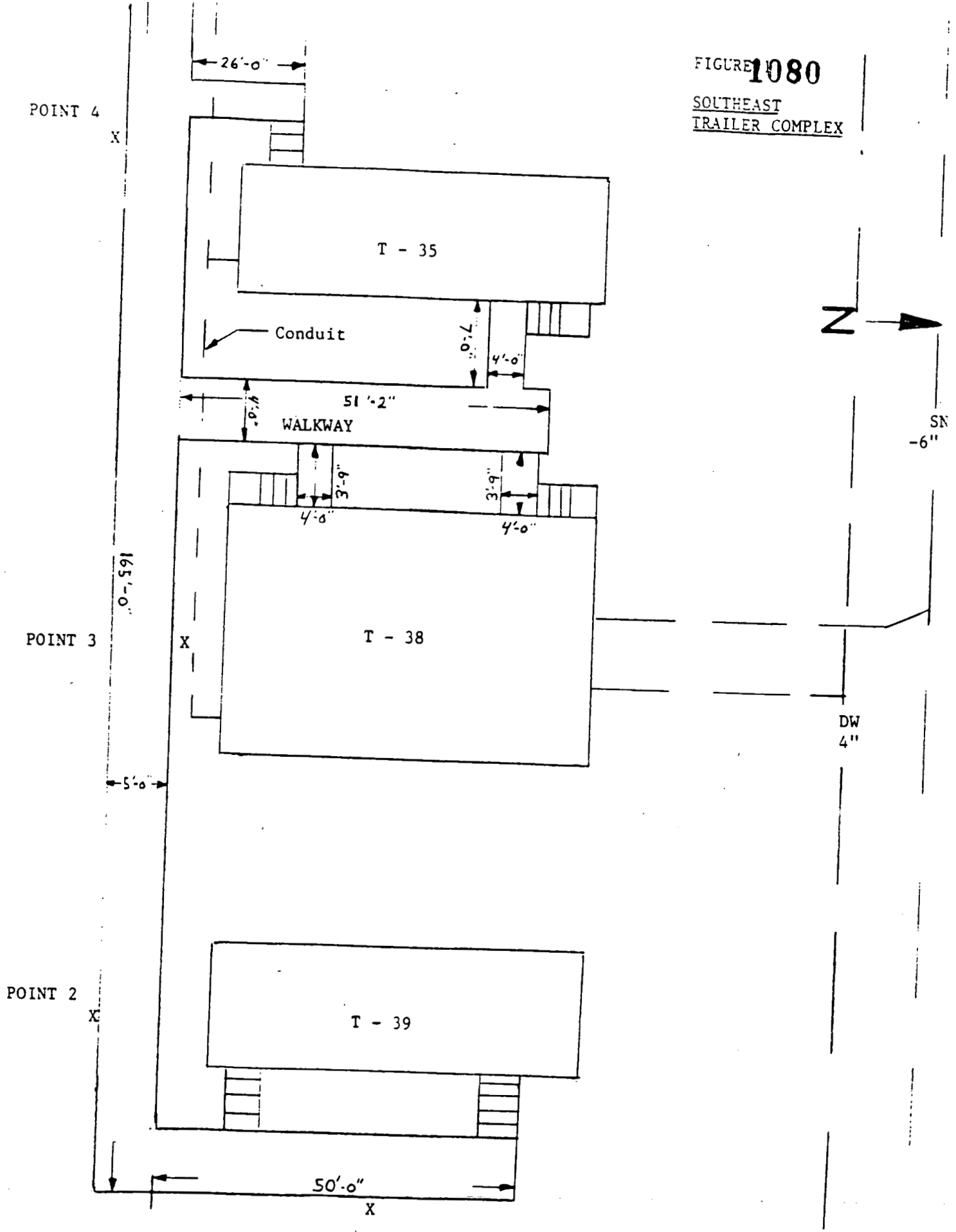
Table 1

THORIUM AND URANIUM ANALYSIS OF SOIL SAMPLES

Sample Point	Depth	Analysis	Result		Level of Concentration
#1-0	surface	Total U	49	ppm	Category 2
#1-0	surface	Total Th	<18	ppm	Category 1
#2-0	surface	Total U	48	ppm	Category 2
#2-0	surface	Total Th	<18	ppm	Category 1
#3-0	surface	Total U	64	ppm	Category 2
#3-0	surface	Total Th	<18	ppm	Category 1
#4-0	surface	Total U	67	ppm	Category 2
#4-0	surface	Total Th	<18	ppm	Category 1
#54-0	surface	Total U	65	ppm	Category 2
#54-0	surface	Total Th	<18	ppm	Category 1
#55-0	surface	Total U	70	ppm	Category 2
#55-0	surface	Total Th	<18	ppm	Category 1
#56-0	surface	Total U	185	ppm	Category 3
#56-0	surface	Total Th	<18	ppm	Category 1
#57-0	surface	Total U	80	ppm	Category 2
#57-0	surface	Total Th	<18	ppm	Category 1
#1-1	1 foot	Total U	<11	ppm	Category 1
#1-1	1 foot	Total Th	<18	ppm	Category 1
#2-1	1 foot	Total U	<11	ppm	Category 1
#2-1	1 foot	Total Th	<18	ppm	Category 1
#3-1	1 foot	Total U	<11	ppm	Category 1
#3-1	1 foot	Total Th	<18	ppm	Category 1
#4-1	1 foot	Total U	<11	ppm	Category 1
#4-1	1 foot	Total Th	<18	ppm	Category 1
#54-1	1 foot	Total U	19	ppm	Category 1
#54-1	1 foot	Total Th	<18	ppm	Category 1
#55-1	1 foot	Total U	47	ppm	Category 1
#55-1	1 foot	Total Th	<18	ppm	Category 1
#56-1	1 foot	Total U	16	ppm	Category 1
#56-1	1 foot	Total Th	<18	ppm	Category 1

FIGURE 1080

SOUTHEAST TRAILER COMPLEX



X Denotes sample point

T Denotes trailer

ATTACHMENT 1

ESTIMATION OF DOSES AND RISKS ASSOCIATED WITH THE INSTALLATION OF CONCRETE SIDEWALKS AT SELECTED TRAILER COMPLEXES

There are a total of four surface sample points identified in Figure 1, the Southeast Trailer Complex. Total uranium, assumed to be represented by a natural isotopic activity distribution, characterizes the only radionuclide of concern. The average concentration represented by the four measurements was determined to be:

57 parts per million = Average Concentration at Southeast Trailer Complex.

Assuming a natural isotopic activity distribution would correspond to the following activities:

Total Uranium ~ 40 pCi/g

U-238 = 19.5 pCi/g

U-235 = 0.9 pCi/g

U-234 = 19.5 pCi/g

There are four sample points identified in Figure 2, the Trailer Complex South of the Laboratory Building. The samples identified in Figure 2 range in concentration from 65 (parts per million) ppm to 185 ppm with three being between 65 ppm and 80 ppm. An average surface soil concentration was found to be 100 ppm. The 100 ppm value, although probably not a completely realistic source average, will be utilized since it represents a conservative estimate. Activities, based on a natural isotopic activity distribution, would correspond as follows to the mass ratios which were in units of ppm.

Total Uranium = 66.7 pCi/g

Uranium-238 = 32.5 pCi/g

Uranium-235 = 1.5 pCi/g

Uranium-234 = 32.5 pCi/g

Although a natural isotopic activity distribution was assumed for the uranium isotopes, the uranium contamination is assumed to be NORMAL in content, meaning that the uranium has been processed and the only daughters which are included in the dose and risk calculations are the immediate, short-lived daughters, which are thorium-234 and protactinium-234. Also, it must be noted that the source term was characterized strictly in terms of total uranium, parts per million, and then converted to isotopic specific activities. This approach results in a bias of greater conservatism.

EXPOSURE SCENARIO AND PARAMETERS

The two exposure scenarios evaluated in this assessment are identified in Items (1) and (2) of the introduction. The first exposure scenario is the exposure to a worker who walks through the contaminated areas on a daily basis. The second exposure scenario evaluates the worker who removes the existing wooden sidewalks

$T(t)$ = Contaminated zone thickness at time t, 0.1 meters.

d_m = Mixing depth, default of 0.15 meters. The subscript "i" and the subscript "2" represents the ith radionuclide and the inhalation pathway, respectively.

The cover and depth factor represents the fraction of resuspended soil particles at the ground surface that are contaminated. It is calculated by assuming that the mixing of the soil will occur within a layer of thickness d_m at the surface (USDOE, 1989). The $C_d(t)$ represents the time dependent uncontaminated cover depth in units of meters. While $T(t)$ represents the time dependent contaminated zone thickness depth in units of meters.

FI_2 = Inhalation Rate, 8400 m^3/yr.

EXPOSURE PATHWAYS AND METHODOLOGY

The direct radiation pathway is shown in Equation (1) below:

$$\text{DOSE (mrem/yr)} = DCF_{i1} \times \text{Bulk Density} \times \text{Source Conc.} \times EF \times FA_1 \times FS \quad (1)$$

DCF_{i1} = (mrem/yr)/(pCi/cm^3).

Bulk Density of soil where a default value of 1.8 g/cm^3 is used.

Source Term = Picocuries/Gram of Soil for the ith radionuclide.

FS = Shape Factor, 1.

FA_1 = Area Factor, 1.

EF = Occupancy and Exposure factor.

0.0286 = Exposure Scenario #1.
0.0394 = Exposure Scenario #2.

The inhalation of resuspended dust pathway is shown in Equation (2) below:

$$\text{DOSE (mrem/yr)} = ASR \times FA_2 \times FCD_{i2}(t) \times EF \times FI_2 \times \text{Source Term} \times DCF_{i2} \quad (2)$$

ASR = Air-to-Soil resuspension factor, 2×10^{-4} g/m^3 is the typically used value (USDOE, 1989).

FA_2 = Area Factor for the inhalation pathway, designated by a subscript 2.

	Southeast	Lab Building
$FA_{2*} = A^{1/2}/(A^{1/2} + DL) =$	$159^{1/2}/(159^{1/2}+3)$ = 0.81	$91^{1/2}/(91^{1/2}+3)$ =0.76

Where DL = Dilution length, default value of 3 meters (USDOE, 1989).

Table 3-1: Results For Southeast Trailer Complex - Exposure Scenario #1

Radionuclide	Ave. Source Concentration (pCi/g)	DCF_{i1} (mrem/yr)/ pCi/cm^3)	Dose (mrem/yr)	Risk/yr*
U-238+D	19.5	6.97×10^{-2}	7.0×10^{-2}	1.4×10^{-8}
U-235+D	0.9	4.9×10^{-1}	2.3×10^{-2}	4.5×10^{-9}
U-234	19.5	6.97×10^{-4}	7.0×10^{-4}	1.4×10^{-10}
Total	-	-	9.4×10^{-2}	1.9×10^{-8}

Table 3-2: Results For Trailer Complex South of Lab Building - Exposure Scenario #1

Radionuclide	Source Concentration (pCi/g)	DCF_{i1} (mrem/yr)/ (pCi/cm^3)	Dose (mrem/yr)	Risk/yr*
U-238+D	32.5	6.97×10^{-2}	1.2	2.3×10^{-8}
U-235+D	1.5	4.9×10^{-1}	0.04	7.8×10^{-9}
U-234	32.5	6.97×10^{-4}	1.75×10^{-3}	3.5×10^{-10}
Total	-	-	1.2	3.1×10^{-8}

* Based on BEIR III Risk coefficient of 2×10^{-7} Risk/mrem.

+D = Aggregated Dose Conversion Factors for intake of principal radionuclides plus radionuclides of associated decay chain in secular equilibrium.

Inhalation of Resuspended Dust.

Dose = DCF_{i1} x ASR x FA_2 x Source Term x FCD_{i2} x EF x FI_2

Table 3-4: Results For Southeast Trailer Complex - Inhalation Pathway For Exposure Scenario #2

Radionuclide	Source Concentration (pCi/g)	DCF_{i1} (mrem/yr)/ (pCi/cm^3)	Dose (mrem/yr)	Risk/yr*
U-238+D	19.5	1.2×10^{-1}	8.4×10^{-2}	1.7×10^{-8}
U-235+D	0.9	1.2×10^{-1}	2.8×10^{-3}	7.8×10^{-10}
U-234	19.5	1.3×10^{-1}	9.2×10^{-2}	1.8×10^{-8}
Total	-	-	1.8×10^{-1}	3.6×10^{-8}

TOTAL RISK = $2.6 \times 10^{-8} + 3.6 \times 10^{-8} = \underline{6.2 \times 10^{-8}}$

* Based on BEIR III Risk Coefficient of 2 x10^{-7} risk/mrem.

+D = Aggregated Dose Conversion Factors for intake of principal radionuclide plus radionuclides of associated decay chain in secular equilibrium.

Southeast Trailer Complex
Total Risk = 6.2×10^{-8}

Trailer Complex South of Lab Building
Total Risk = 1.2×10^{-7}

The highest risk (approximately 3 chances in 10 million of dying of an excess cancer) is shown for a worker who frequently walks past the contaminated region associated with the wooden sidewalks south of the laboratory building on a daily basis for a year. These risks are based on several assumptions, outlined below, which greatly exaggerate the doses and associated risks.

1) A constant homogeneous source distribution.

2) Conservative, hypothetical exposure scenarios.

3) A uniform source distribution.

4) A conservative dust resuspension factor.

Even considering the above assumptions, the doses estimated in this assessment can be considered insignificant since natural sources have been estimated by the NCRP to deliver a dose of approximately 300 millirem per year (NCRP, 1987). Manmade sources deliver a dose of approximately 70 millirem per year. The EPA and NRC have proposed BRC (Below Regulatory Concern) dose levels of between 4 to 10 mrem per year, committed effective dose equivalent, for an individual and 1 mrem per year for population exposures. As a result, the risks estimated are in the range of proposed "diminis levels" (Travis, 1989).

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