137270
M-538

Formerly Utilized Sites Remedial Action Program (FUSRAP)

ADMINISTRATIVE RECORD

for Maywood, New Jersey

U.S. Department of Energy

0489-0613.1

137270

Department of Energy

Oak Ridge Operations Office
P.O. Box 2001
Oak Ridge, Tennessee 37831—8723

December 4, 1995

Ms. Angela Carpenter
Federal Facilities Section
U.S. Environmental Protection Agency, Region II
290 Broadway
New York, New York 10007-1866

Dear Ms. Carpenter:

MAYWOOD SITE -- PROPOSED USE OF SUPPLEMENTAL STANDARDS

The purpose of this letter is to present DOE's proposal to use supplemental cleanup criteria on some of the Phase I Maywood vicinity properties. As we have discussed, supplemental standards may be appropriate under the following conditions: 1) when the removal of radioactive materials to the cleanup criteria would produce harm to the environment that is clearly excessive compared to a small reduction of risk; 2) when the estimated cost for removal of radioactive materials would be disproportionately high relative to a small reduction of risk; or 3) when the removal of radioactive materials would present a clear and present risk of injury to the public or to remedial action personnel.

As we have discussed, the application of supplemental criteria is considered an acceptable approach and has been implemented at a number of sites by both DOE and EPA. Their use is explicitly provided for under DOE directives (DOE Order 5400.5 and proposed 10 CFR 834 regulations) and EPA regulations pertaining to residual radioactive materials similar to those at the Maywood site (40 CFR 192). In all cases, supplemental criteria would be proposed only where it can be demonstrated that residual risks are estimated to be within EPA's Superfund target risk range of 10^{-4} to 10^{-6}.

Enclosed please find a summary of guiding principles (Attachment A) that are being proposed for use to help determine when to apply supplemental criteria. Attachment B presents several example scenarios which are being proposed for supplemental criteria. The scenarios are modeled using RESRAD Version 5.61 to obtain dose and risk information.

At this time I am requesting your approval of our proposed approach. If we are in agreement on the guiding principles and on the modeling assumptions then this spring we will gather additional data to support a hazard assessment. At this time, of the Phase I properties scheduled to be remediated this fiscal year, we are considering the use of supplemental standards for an area behind Long Valley Road that has a blanket of mature trees that is currently a sound barrier to the traffic on Interstate 80. Whether we are able to apply supplemental standards to this location will depend on the data that is collected.

If you have any questions or would like to discuss the enclosed information in greater detail please call me at (423) 576-5724.

Sincerely,

Susan M. Cange, Site Manager
Former Sites Restoration Division

Enclosures

cc: Nick Marton, NJDEP
Alexander Williams, DOE-HQ

ATTACHMENT A

Guiding Principles for Hazard Assessment for the

Maywood Phase I Removal Action

GUIDING PRINCIPLES FOR HAZARD ASSESSMENTS FOR THE MAYWOOD PHASE I REMOVAL ACTION

Primary cleanup criteria for the planned removal of residual radioactive materials from residential and municipal vicinity properties at the Maywood site include the following:

- Allowable concentrations of thorium-232 and radium-226 (Th-232 + Ra-226 combined) in soil shall not exceed 5 pCi/g above background, averaged over any 100 m^2 area and 15 cm (6 in.) depth interval.

- Allowable concentrations of total uranium in soil shall not exceed 100 pCi/g above background, averaged over any 100 m^2 area. This would yield an uranium-238 (U-238) concentration of approximately 50 pCi/g. (In practice, it is anticipated that residual concentrations of U-238 following remediation would be far below 50 pCi/g, since the U-238 tends to be co-located with Th-232 at the Maywood site and at similar or lower concentrations).

- Allowable concentrations of radon in indoor air shall not exceed 4 pCi/L including background under current or plausible future conditions. Radon decay product concentrations shall not exceed 0.02 working levels (WL) (including background) where reasonably achievable and 0.03 WL in any case.

Under some conditions, supplemental criteria may be proposed to permit concentrations of residual radioactive materials above the primary criteria (i.e., above 5 pCi/g). The use of supplemental criteria is explicitly provided under DOE directives (DOE Order 5400.5 and proposed 10 CFR Part 834 regulations) and EPA regulations pertaining to residual radioactive materials similar to those at the Maywood site (40 CFR Part 192). EPA states that: "Remedial action will generally not be necessary where residual radioactive materials have been placed semi-permanently in a location where site-specific factors limit their hazard and from which they are costly or difficult to remove, or where only minor quantities of residual radioactive materials are involved."

In each case, the protectiveness of the proposed supplemental criteria must be documented in a site-specific hazard assessment. Supplemental criteria would be proposed only where both of the following conditions are met:

I. The site-specific hazard assessment must demonstrate that the supplemental criteria would provide adequate protection of human health and the environment under current conditions and plausible future conditions at the property. For purposes of this evaluation, protectiveness will be evaluated using a dose limit of 30 mrem/yr (total effective dose equivalent excluding radon) from the residual radioactive materials - i.e., the dose to the reasonable maximally exposed individual at that property may not exceed

30 mrem/yr under current conditions or any plausible future conditions[1], and would be kept as low as reasonably achievable (ALARA).

II. In cases where the protectiveness criterion (I.) is met, the applicability of supplemental criteria would be evaluated based on the following considerations:

- The areal and vertical extent of the residual radioactive materials covered under the supplemental criteria;
- site-specific conditions that limit the accessibility of the residual radioactive materials, including depth of clean soil cover or coverage by permanent buildings, mature trees, or public roadways;[2]
- the cost of removal of the residual radioactive materials to the primary criteria;
- potential risks to remedial action personnel or the public that may result from the removal of the residual radioactive materials to the primary criteria; or
- potential harm to the environment that may result from the removal of the residual radioactive materials to the primary criteria.

Supplemental criteria may be proposed where one or more of the following conditions are met:

a. The removal of the residual radioactive materials to the primary criteria would present a clear and present risk of injury to remedial action personnel or the public.

b. The removal of the residual radioactive materials to the primary criteria would produce harm to the environment that is clearly excessive compared to the small risk reduction benefits; for the properties considered in this removal action, this

---

[1] For purposes of this analysis, the most conservative (i.e., most protective) plausible future land use is considered to be urban residential use for properties addressed under Phase I. The urban resident scenario includes external exposure, particulate inhalation, produce ingestion, and incidental soil ingestion pathways. The resident is assumed to obtain 10% of his/her produce from a home garden. On-site production of meat, milk, or fish is not considered, and all water is obtained from an off-site source (i.e., a municipal water supply).

[2] Site-specific features that will be considered to limit access to residual radioactive materials in soil include permanent structures, public roadways, mature trees, or a layer of clean soil overburden of 4 ft (the approximate frostline depth) or greater. Permanent structures are defined to include houses and inhabitable buildings (e.g., the fire station), but do not include detached garages, sheds, or similar structures. Soils located beneath public roads will be considered as candidates for application of supplemental criteria, but soils beneath driveways and sidewalks will not be considered except where the depth of clean soil overburden is 4 ft or greater. Soils located beneath mature trees (e.g., trunk diameter greater than 6 inches) also will be evaluated on a property-specific basis for potential applications of supplemental criteria.

criterion will consider potential damage to mature trees that may be impacted by removal actions.

c. The estimated cost for removal of the residual radioactive materials to the primary criteria would be disproportionately high relative to small risk reduction benefits.

For the planned removal activities, it is anticipated that supplemental criteria may be proposed due to conditions (b) and (c), but probably not condition (a) because it is expected that appropriate mitigative measures can be applied to minimize risk to workers and the public regardless of the cleanup criteria. However, it may not be possible to achieve the primary criteria without damage to large trees or without incurring unreasonably high costs. Supplemental criteria would be proposed only for situations where the current and future risk from the residual radioactive materials is acceptably low, as defined above, and the potential risk reduction is small.

Supplemental criteria may be proposed for areas of residual radioactive materials which occur in locations where the plausible exposure pathways are limited and the potential dose to the public is very low. In addition to conditions identified by DOE as warranting consideration for hazard assessment, analyses may be conducted at the request of the property owners to attempt to avoid damage to important site features, such as mature trees, which may have particular sentimental, emotional, or aesthetic value. In all cases, however, supplemental criteria would be proposed only where they can be demonstrated to present no unacceptable risk to current or future occupants, as described under condition (I.) above.

ATTACHMENT B

Example Scenarios Supporting the Use

of Supplemental Criteria

EXAMPLE SCENARIOS SUPPORTING THE USE OF SUPPLEMENTAL CRITERIA

B.1. Introduction

This analysis presents estimates of radiation doses and incremental cancer risks to potential receptors at two of the Maywood vicinity properties. As discussed in Attachment A, DOE has identified four primary scenarios in which site-specific features limit access to residual radioactive materials. These features are permanent structures, public roadways, mature trees, and layers of clean soil overburden of 1.2 m (4 ft) or greater. The properties along Long Valley Road contain a row of mature trees and the property at 10 Hancock has residual radioactive materials underlying both the house and approximately 2.85 m (9 ft) of clean soil overburden. The Long Valley Road and 10 Hancock scenarios represent maximum exposure scenarios because all other areas that might be considered for supplemental criteria have lower activity concentrations, more clean soil cover, or less surface area.

The properties that are included in this analysis are shown on Figure 1. The dose and risk estimates for these properties have been computed using the RESRAD Version 5.61 computer code (Yu et.al. 1993a), which has been developed to implement the DOE guidelines for residual radioactive material as specified in DOE Order 5400.5 (DOE 1990).

Exposure assumptions for the residual risk analysis were selected to maintain consistency with those previously used in the "Baseline Risk Assessment for the Maywood Site" (DOE 1993) and the DOE statement of position regarding the dispute on cleanup criteria (Price 1993). Key exposure parameter assumptions are presented in Table B-1. Parameter values assumed for site-specific geotechnical characteristics are summarized in Table B-2. Exposure assumptions are considered to be conservative, such that actual doses and risks are expected to be even lower than those estimated here.

Estimates of residual dose and risk are presented for both properties immediately following remediation (if applicable), and also for the future time where the greatest residual risk is predicted, out to a period of 1000 years. The 1000-year period was selected as a reasonable maximum time horizon, as predictions at longer times become increasingly uncertain.

B.2. Source Term Assumed for the Long Valley Properties

A row of mature trees is present along the back of the properties at 18, 20, and 22 Long Valley Road. This row of trees acts as a sound and aesthetic barrier between the properties and Interstate-80. Residual radioactive material above criteria is present in this area ranging from the surface to approximately 1 m in depth. Property-specific source term assumptions are summarized in Table B-3.

Table B-1. Exposure Parameter Assumptions.

Parameter	Units	Input value
Indoor occupancy factor	%	65
Outdoor occupancy factor	%	2
Exposure duration	yrs	30
Indoor gamma shielding factor	%	30
Inhalation rate	m^3/yr	7300
Dust loading	$\mu g/m^3$	200
Dust from soil origin	%	50
Dust respirable fraction	%	30
Soil ingestion rate	g/yr	35
Ingestion of home produce	kg/yr	28
Fraction of drinking water from onsite well	-	0

Table B-2. Geotechnical Parameter Assumptions.

Parameter	Assumed Value
Contaminated zone total porosity	0.45
Contaminated zone effective porosity	0.26
Contaminated zone hydraulic conductivity	1.23 m/yr
Saturated zone total porosity	0.45
Saturated zone effective porosity	0.26
Saturated zone hydraulic conductivity	123 m/yr
Saturated zone hydraulic gradient	0.01
Unsaturated zone thickness	1 m
Unsaturated zone total porosity	0.45
Unsaturated zone effective porosity	0.26
Unsaturated zone hydraulic conductivity	1.23 m/yr
Precipitation rate	1.07 m/yr
Runoff coefficient	0.25
Average annual wind speed	4.6 m/s
Soil specific b	5.3
Soil density	1.6 g/cm^3
Well pump intake depth below water table	1 m
Soil erosion rate[a]	6 x 10^{-5} m/yr
Distribution coefficient, K_d[b]	
Thorium	60,000
Radium	450
Uranium	450
Lead	900
Actinium	1,500
Protactinium	2,500

[a] Reference: Yu et.al. 1993b.

[b] Reference: Baes et.al. 1984; Sheppard and Thibault 1990.

Table B-3. Source Term Assumptions for Long Valley Properties.

Parameter	Units	Long Valley Rd Trees
Area of contaminated zone	m^2	770
Thickness of contaminated zone	m	1
Cover depth	m	0.15
Radionuclide concentrations	pCi/g	
Th-232 + Progeny		12
Ra-226 + Progeny		1.4
U-238 + Progeny		4.4
U-234		0.2
U-235 + Progeny[a]		

[a] Assumed 4.6% of U-238 concentration, based on relative isotopic abundance.

For the purpose of the residual risk evaluation, it is assumed that 0.15 m (6 in.) of soil would be removed during remediation and replaced with clean soil creating a clean surface cover of 0.15 m. This scenario is plausible because surface contamination could be removed without harming the trees.

Average activity concentrations were calculated using data presented in Table B-4. This data was collected in October of 1995 and has not yet been reported in a document that can be referenced. Eight boreholes were drilled in the backyards of 18, 20, and 22 Long Valley Road. The boreholes were evenly spaced along the rear of the yards in the area which contains subsurface residual radioactive material above criteria.

As discussed in Attachment A, the urban resident scenario includes external exposure, particulate inhalation, and incidental soil ingestion pathways. Produce ingestion was not included in this analysis because it is unlikely that a homeowner would place a garden in this area of trees and brush. On-site production of meat, milk, or fish is not considered, and all water is obtained from an off-site source (i.e., a municipal water supply). The radon inhalation pathway is also modeled and compared against the guidelines of 4 pCi/L and 0.02 working levels (WL).

Table B-4. Radionuclide Concentrations.

Borehole	Depth of sample (cm)	Th-232 (pCi/g)	Ra-226 (pCi/g)	U-238 (pCi/g)
95R01	15 - 30	6.38	0.99	5.13
95R03	45 - 60	13.2	1.63	5.66
95R06	0 - 15	13.1	1.60	9.68
95R08	0 - 15	9.25	1.17	0.21
95R09	15 - 30	22.7	2.15	7.98
95R11	30 - 45	4.60	0.64	0.135
95R12	45 - 60	11.4	0.88	0.175
95R15	30 - 45	15.3	1.78	6.03
	Average =	**12**	**1.4**	**4.4**

B.3. Source Term Assumed for the Property at 10 Hancock

The property at 10 Hancock has a lens of residual radioactive material overlain by clean soil approximately 2.85 m (9 ft) thick. The lens of material covers approximately two-thirds of the property including the house. Higher concentrations are present at 10 Hancock than the majority of residential vicinity properties which means it will provide a conservative estimate of dose. For simplicity and conservatism, the same property (10 Hancock) is used as an example of residual material under both a permanent structure and a clean soil overburden greater than 1.2 m (4 ft). Property-specific source term assumptions are indicated in Table B-5.

The original characterization of 10 Hancock was performed in the 1980's (BNI 1989). During this characterization, gamma radiation readings were taken throughout the depth of auger holes. Soil samples were collected only of surficial soil. However, the RESRAD model requires input data in activity concentrations (pCi/g). In the Maywood area, a precise correlation between gamma readings (in counts per minute) and activity concentrations of thorium-232 has not been established because of the large and varying amounts of potassium-40 in the area. In March of 1995, a hole was drilled through the basement of the home and a soil sample was collected from the depth that emitted the highest gamma radiation (George 1995). The resultant concentrations for thorium-232, radium-226, and uranium-238 are used in this risk analysis and correlate with historical data.

Table B-5. Source Term Assumptions for 10 Hancock.

Parameter	Units	Permanent Structure	Clean Soil Overburden
Area of contaminated zone	m^2	116	465
Thickness of contaminated zone	m	0.3	0.3
Cover depth	m	0.9	2.85
Radionuclide concentrations	pCi/g		
Th-232 + Progeny		23.8	23.8
Ra-226 + Progeny		1.6	1.6
U-238 + Progeny		3.6	3.6
U-234		0.166	0.166
U-235 + Progeny[a]			

[a] Assumed 4.6% of U-238 concentration, based on relative isotopic abundance.

The permanent structure scenario for 10 Hancock models the dose to a resident living entirely in the basement of the home. The lens of residual material begins 0.9 m below the bottom of the basement floor slab. It is assumed for this scenario that the residual radioactive material in the yard of the property is remediated leaving only the material under the house. The only plausible exposure pathways are external gamma exposure and radon inhalation.

The clean soil overburden scenario for 10 Hancock models the dose to a resident if no remediation occurs. The lens of residual material is overlain by 2.85 m of clean soil. The risk analysis for 10 Hancock includes external exposure, particulate inhalation, produce ingestion, and incidental soil ingestion. The resident is assumed to obtain 10% of his/her produce from a home garden in the area of interest. Again, radon inhalation is also modeled and compared against EPA guidelines.

B.4. Estimates of Dose and Risk

Estimates of total effective dose equivalent (TEDE) (excluding radon), lifetime excess cancer risk (excluding radon), radon concentration, and working level for residents at the properties following completion of any remedial activities are summarized in Table B-6. Results of this analysis indicate that the example scenarios will not exceed the protectiveness criteria of 30 mrem/yr as discussed in Attachment A. Estimates of excess cancer risk are within EPA's target risk range of 10^{-6} to 10^{-4}.

Furthermore, estimates of radon levels do not exceed the 4 pCi/L concentration limit or 0.02 WL.

The permanent structure and the clean soil overburden scenario have the same results because the dose from the contamination under the home to a resident living in the basement is approximately ten orders of magnitude greater than the dose from the material in the yard. The difference in dose is due to the difference in cover depth. The Long Valley Road and 10 Hancock scenarios represent maximum exposure scenarios because all other areas that might be considered for supplemental criteria have lower activity concentrations, more clean soil cover, or less surface area. Thus, actual doses and risks are expected to be lower.

Table B-6. Estimated Dose and Risk from Supplemental Criteria.

Property	TEDE[a] (mrem/yr)	Lifetime Excess Cancer Risk[a]	Radon Concentration (pCi/L)[a]	Working Level[a]
Long Valley Trees	0.6 1.3	4×10^{-6} 1×10^{-5}	1×10^{-3}	7×10^{-9}
10 Hancock Permanent Structure	1×10^{-3} 2×10^{-3}	4×10^{-9} 8×10^{-9}	0.1	9×10^{-4}
10 Hancock Clean Soil Overburden	1×10^{-3} 2×10^{-3}	4×10^{-9} 8×10^{-9}	0.1	9×10^{-4}

[a] Top value represents time=0; bottom value is maximum dose/risk over the period of analysis (t=1000 yrs), if different from t=0.

REFERENCES

Baes, C.F., et.al., 1984, "A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides Through Agriculture," ORNL-5786.

Bechtel National, Inc., 1989, "Radiological Characterization Report for the Residential Property at 10 Hancock," DOE/OR/20722-242.

George, A.K., 1995, "Results of Maywood vicinity property data gap characterization," FUSRAP Technical Memorandum #138-95-013, Rev.1 sent to M.E. Redmon on 08/09/95.

Price, L.K., 1993, "Revised DOE statement of position regarding the dispute on cleanup criteria," correspondence sent to W. Muszynski and J. La Grone on 09/30/93.

Sheppard, M.I., and D.H. Thibault, 1990, "Default Soil Solid/Liquid Partition Coefficients, K^ds, for Four Major Soil Types: A Compendium," *Health Physics*, Vol.59 No.4, pp 471-482.

U.S. Department of Energy, 1990, "Radiation Protection of the Public and Environment," DOE Order 5400.5.

U.S. Department of Energy, 1993, "Baseline Risk Assessment for the Maywood Site, Maywood, New Jersey," March 1993.

Yu, C., et.al., 1993a, "Manual for Implementing Residual Radioactive Material Guidelines", Draft.

Yu, C., et.al., 1993b, "Data Collection Handbook to Support Modeling the Impacts of Radioactive Material in Soil," ANL/EAIS-8, April 1993.