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REVISIONS TO THE OPERABLE UNIT 4 REMEDIAL INVESTIGATION FINAL REPORT

03/18/94

DOE-1282-94
DOE-FN/EPA
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LETTER
OU4

Department of Energy
Fernald Environmental Management Project
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MAR 18 1994

DOE-1282-94

Mr. James Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - 5HRE-8J
77 W. Jackson Boulevard
Chicago, IL 60606-3590

Mr. Graham Mitchell, Project Director
Ohio Environmental Protection Agency
40 South Main Street
Dayton, OH 45402-2085

Dear Mr. Saric and Mr. Mitchell:

REVISIONS TO THE OPERABLE UNIT 4 REMEDIAL INVESTIGATION FINAL REPORT

Enclosed are revisions (Enclosure 1) made by the Department of Energy, Fernald Field Office (DOE-FN) to the Operable Unit 4 (OU4) Remedial Investigation (RI) Final Report which was officially transmitted, during November 1993, to the United States Environmental Protection Agency (USEPA). The revisions to Sections 6 and 7, and Appendix D of the RI were required as a result of review by the USEPA. Problems with the clarity and completeness of the comment responses were pointed out by the USEPA in a telephone conversation with representatives of the DOE on March 1, 1994.

The comment responses provided by the DOE-FN were found to contain several discrepancies with risk estimates reported in Appendix D and those provided in Section 6 of the RI, where the risk results were to be summarized. DOE-FN failed to make the distinction between risk due to radiological contamination of environmental media and the risk due to external radiation from material within the K-65 Silos. The external radiation risks, from the silos, to the various receptors is reported in Table D.5-2. In the enclosed package, the risk estimates are clearly delineated with parenthetical statements. In addition Table D.5-2 was revised to include a note indicating those receptors used in the overall risk assessment evaluation.

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Recycled and Recyclable

The footnotes on the tables included in the enclosures to Appendix D have been reviewed for accuracy and the appropriate changes are highlighted in the enclosed redlined pages (Enclosure 2). Additionally, the text related to the bio-kinetic uptake model for lead has been revised.

Please contact Randi Allen at (513) 648-3102 if there are any additional questions regarding this submittal.

Sincerely,

Johnny Reising

for Jack R. Craig
Fernald Remediation Action
Project Manager

FN:Allen

Enclosure: As Stated

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ATTACHMENT I

OPERABLE UNIT 4 REMEDIAL INVESTIGATION FINAL REPORT REPLACEMENT CHANGE PAGES

Quantitative toxicity estimates are presented in Appendix D in Tables D.4-1, D.4-2, and D.4-3 for chemical toxicants, for carcinogens, and for radionuclides, respectively, for which toxicity values are available.

6.5 RISK CHARACTERIZATION RESULTS

Table 6-1 and 6-2 shows the baseline risks and hazard indices for each hypothetical receptor by land-use and source-term scenario. These tables summarize the information of Appendix D, Section D.5, including the constituent specific risk summary tables of that section. Risk values in Table 6-1 are reported in units of ILCR for radiological, chemical, and total risk. The chemical HI, which has no units, is presented in Table 6-2.

6.5.1 Current Land-Use Without Access Control/Current Source-Term Scenario

The receptor with the greatest total radiological risk is the trespassing child (Table 6-1). The greatest contributor under this scenario is from exposure to external radiation while the receptor is on top of the Silo 1 or 2 dome (5×10^{-3}). In addition, the receptor is exposed to air, soil, and surface water pathways resulting in radiological risk of 3×10^{-5}. The total radiological risk to the trespassing child is 5×10^{-3} (external radiation) plus 3×10^{-5} (nuclide-specific radiation) totalling 5×10^{-3}. The receptor with the greatest total chemical risk (1×10^{-4}), is the off-property resident farmer (Table 6-1). The greatest contribution under this scenario is from exposure to air pathways (1×10^{-4}). The receptor with the greatest total radiological plus chemical risk under this scenario (5×10^{-3}, Table 6-1) is the trespassing child. The greatest HI is 0.3 to the trespassing child (Table 6-2). The greatest contribution, under this scenario is from soil exposure pathways (0.2).

6.5.2 Current Land-Use Without Access Control/Future Source-Term Scenario

The receptor with the greatest total radiological risk is the groundskeeper (Table 6-1). The greatest contribution under this scenario is from exposure to soil pathways (2×10^{-2}). The total radiological risk to the groundskeeper under this scenario is 3×10^{-2} (Table 6-1). The receptor with the greatest total chemical risk is also the groundskeeper (Table 6-1). The greatest contribution is from exposure to soil pathways (5×10^{-4}). The total chemical risk to the groundskeeper under this scenario is 6×10^{-4}. The total radiological plus chemical risk to the groundskeeper under this scenario is 3×10^{-2} (Table 6-1). The greatest HI is 20 to the groundskeeper (Table 6-2) and to the trespassing child (Table 6-2). The greatest contribution to both receptors under this scenario is from exposure to air pathways.

6.5.3 Current Land-Use With Access Control/Current Source-Term Scenario

This scenario most closely approximates current conditions at the FEMP site. However, as discussed in Appendix D, the risk and HI results for this scenario are numerically the same as the results for the current land-use scenario without access controls assuming the current source term (Section 6.5.1). This is because the presence or absence of access controls does not change the numerical values of

TABLE 6-1

INCREMENTAL LIFETIME CANCER RISK SUMMARY ALL SOURCES/ALL PATHWAYS

Land Use/ Source Term Scenario	Type of Risk	Trespassing Child	Grounds Keeper	Off-Property Resident Farmer	Off-Property User of Surface Water	CT On-Property Resident Farmer	RME On-Property Resident Farmer[a]	On-Property Resident Child
Current Land Use without Access Control/Current Source Term Scenario	Radiological-Nuclide Specific[b]	3.0×10^{-5}	8.0×10^{-5}	1.0×10^{-5}	1.0×10^{-7}	NA[c]	NA	NA
	Radiological-External[d]	5×10^{-3}	1×10^{-4}	NA	NA	NA	NA	NA
	Chemical Risk	1.0×10^{-5}	2.0×10^{-5}	1.0×10^{-4}	1.0×10^{-7}	NA	NA	NA
	Total Risk	5.0×10^{-3}	2.0×10^{-4}	1.0×10^{-4}	2.0×10^{-7}	NA	NA	NA
Current Land Use without Access Control/Future Source Term Scenario	Radiological-Nuclide Specific	1.0×10^{-2}	3.0×10^{-2}	2.0×10^{-3}	1.0×10^{-6}	NA	NA	NA
	Chemical Risk	4.0×10^{-4}	6.0×10^{-4}	2.0×10^{-4}	7.0×10^{-7}	NA	NA	NA
	Total Risk	1.0×10^{-2}	3.0×10^{-2}	2.0×10^{-3}	2.0×10^{-6}	NA	NA	NA
Current Land Use with Access Control/Current Source Term Scenario	Radiological-Nuclide Specific	3.0×10^{-5}	NA	1.0×10^{-5}	1.0×10^{-7}	NA	NA	NA
	Radiological-External	5.0×10^{-3}	NA	NA	NA	NA	NA	NA
	Chemical Risk	1.0×10^{-5}	NA	1.0×10^{-4}	1.0×10^{-7}	NA	NA	NA
	Total Risk	5.0×10^{-3}	NA	1.0×10^{-4}	2.0×10^{-7}	NA	NA	NA
Future Land Use/Current Source Term Scenario	Radiological-Nuclide Specific	NA	NA	1.0×10^{-5}	1.0×10^{-7}	2.0×10^{-4}	3.0×10^{-3}	3.0×10^{-4}
	Radiological-External	NA	NA	NA	NA	2.0×10^{-4}	2.0×10^{-3}	9.0×10^{-3}
	Chemical Risk	NA	NA	1.0×10^{-4}	1.0×10^{-7}	5.0×10^{-3}	8.0×10^{-2}	5.0×10^{-2}
	Total Risk	NA	NA	1.0×10^{-4}	2.0×10^{-7}	5.0×10^{-3}	9.0×10^{-2}	6.0×10^{-2}
Future Land Use/ Future Source Term Scenario	Radiological-Nuclide Specific	NA	NA	2.0×10^{-3}	1.0×10^{-6}	1.0×10^{-1}	1.0×10^{0}	1.0×10^{-1}
	Chemical Risk	NA	NA	2.0×10^{-4}	7.0×10^{-7}	1.0×10^{-2}	2.0×10^{-1}	9.0×10^{-2}
	Total Risk	NA	NA	2.0×10^{-3}	2.0×10^{-6}	1.0×10^{-1}	>1.0	2.0×10^{-1}

[a]The ILCR values were identical for the future land use/future source term scenario evaluated for either the Great Miami Aquifer or for perched water.
[b]The ILCR result from exposure to radionuclides from air, water, (ground and surface), soil and sediment as detailed in Attachment II of Appendix D and summarized in tables within Section D.5.
[c]NA signifies not applicable.
[d]This risk results from exposure to direct external radiation from large sources (Silos 1, 2, and 3) and are presented in Table D.5-2. It does not include exposure to external radiation emanating from radionuclides in surface soils. These later risk are accounted for in the nuclide-specific ILCR.

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exposure parameter values for receptors. The trespassing child's exposure parameter values reflect the standard scenario specified by EPA and the off-property resident farmer, and surface water use exposures are not impacted by the status of access controls.

6.5.4 Future Land-Use/Current Source-Term Scenario

The receptor with the greatest total radiological risk is the on-property resident child (Table 6-1). The greatest contribution under this scenario is from exposure to external radiation while the receptor is on top of the Silo 1 or 2 dome (9×10^{-3}). In addition, the receptor is exposed to air, soil, and surface water pathways resulting in a radiological risk of 3×10^{-4}, primarily from the soil pathway (2×10^{-4}). The total radiological risk to the on-property resident child is 9×10^{-3} plus 3×10^{-4} totalling 9×10^{-3}. The receptor with the greatest total chemical risk (8×10^{-2}) is the RME on-property resident farmer (Table 6-1). The greatest contribution under this scenario is from exposure to soil pathways (8×10^{-2}). The receptor with the greatest total radiological plus chemical risk under this scenario (9×10^{-2}, Table 6-1) is the RME on-property resident farmer. The greatest HI is 100 to the on-property resident child (Table 6-2). The greatest contribution under this scenario is from soil exposure pathways (100).

6.5.5 Future Land-Use/Future Source Term Scenario

This represents the most conservative scenario considered under the baseline risk assessment. Within this scenario, a family is assumed to have established a residence within the Operable Unit 4 boundaries. Additionally, the domes of Silos 1 and 2 are assumed to have failed and Silo 3 is assumed to have suffered total structural failure, spreading its contents to the surface of Operable Unit 4. As described in Section D.3, the failure of Silo 3 and the assumed distribution of its contents on the surrounding surface makes it more appropriate to evaluate direct external exposure in a nuclide-specific manner rather than as a large source. With the failure of the domes of Silos 1 and 2 it is no longer appropriate to evaluate direct external radiation exposure at these locations. Therefore, the separate entry in Table 6-1 for external radiation does not appear for the future source term scenario.

The receptor with the greatest total radiological risk is the RME on-property resident farmer (Table 6-1). The greatest contribution under this scenario is from exposure to soil pathways (approaching unity risk). The total radiological risk to the RME on-property resident farmer under this scenario also approaches unity (1) risk. The receptor with the greatest total chemical risk is also the RME on-property resident farmer (Table 6-1). The greatest contribution is from exposure to soil pathways (2×10^{-1}). The total chemical risk to the RME on-property resident farmer under this scenario is 2×10^{-1}. The total radiological plus chemical risk to the RME on-property resident farmer under this scenario exceeds unity (Table 6-1). The greatest HI is 2000 to the on-property resident child (Table 6-2). The greatest contribution to this receptor under this scenario is from exposure to soil pathways.

TABLE 7-1

INCREMENTAL LIFETIME CANCER RISK SUMMARY ALL SOURCES/ALL PATHWAYS

Land Use/ Source Term Scenario	Type of Risk	Trespassing Child	Grounds Keeper	Off-Property Resident Farmer	Off-Property User of Surface Water	CT On-Property Resident Farmer	RME On-Property Resident Farmer[a]	On-Property Resident Child
Current Land Use without Access Control/Current Source Term Scenario	Radiological-Nuclide Specific[b]	3.0×10^{-5}	8.0×10^{-5}	1.0×10^{-5}	1.0×10^{-7}	NA[c]	NA	NA
	Radiological-External[d]	5×10^{-3}	1×10^{-4}	NA	NA	NA	NA	NA
	Chemical Risk	1.0×10^{-5}	2.0×10^{-5}	1.0×10^{-4}	1.0×10^{-7}	NA	NA	NA
	Total Risk	5.0×10^{-3}	2.0×10^{-4}	1.0×10^{-4}	2.0×10^{-7}	NA	NA	NA
Current Land Use without Access Control/Future Source Term Scenario	Radiological-Nuclide Specific	1.0×10^{-2}	3.0×10^{-2}	2.0×10^{-3}	1.0×10^{-6}	NA	NA	NA
	Chemical Risk	4.0×10^{-4}	6.0×10^{-4}	2.0×10^{-4}	7.0×10^{-7}	NA	NA	NA
	Total Risk	1.0×10^{-2}	3.0×10^{-2}	2.0×10^{-3}	2.0×10^{-6}	NA	NA	NA
Current Land Use with Access Control/Current Source Term Scenario	Radiological-Nuclide Specific	3.0×10^{-5}	NA	1.0×10^{-5}	1.0×10^{-7}	NA	NA	NA
	Radiological-External	5.0×10^{-3}	NA	NA	NA	NA	NA	NA
	Chemical Risk	1.0×10^{-5}	NA	1.0×10^{-4}	1.0×10^{-7}	NA	NA	NA
	Total Risk	5.0×10^{-3}	NA	1.0×10^{-4}	2.0×10^{-7}	NA	NA	NA
Future Land Use/Current Source Term Scenario	Radiological-Nuclide Specific	NA	NA	1.0×10^{-5}	1.0×10^{-7}	2.0×10^{-4}	3.0×10^{-3}	3.0×10^{-4}
	Radiological-External	NA	NA	NA	NA	2.0×10^{-4}	2.0×10^{-3}	9.0×10^{-3}
	Chemical Risk	NA	NA	1.0×10^{-4}	1.0×10^{-7}	5.0×10^{-3}	8.0×10^{-2}	5.0×10^{-2}
	Total Risk	NA	NA	1.0×10^{-4}	2.0×10^{-7}	5.0×10^{-3}	9.0×10^{-2}	6.0×10^{-2}
Future Land Use/ Future Source Term Scenario	Radiological-Nuclide Specific	NA	NA	2.0×10^{-3}	1.0×10^{-6}	1.0×10^{-1}	1.0×10^{0}	1.0×10^{-1}
	Chemical Risk	NA	NA	2.0×10^{-4}	7.0×10^{-7}	1.0×10^{-2}	2.0×10^{-1}	9.0×10^{-2}
	Total Risk	NA	NA	2.0×10^{-3}	2.0×10^{-6}	1.0×10^{-1}	>1.0	2.0×10^{-1}

[a]The ILCR values were identical for the future land use/future source term scenario evaluated for either the Great Miami Aquifer or for perched water.
[b]The ILCR result from exposure to radionuclides from air, water, (ground and surface), soil and sediment as detailed in Attachment II of Appendix D and summarized in tables within Section D.5.
[c]NA signifies not applicable.
[d]This risk results from exposure to direct external radiation from large sources (Silos 1, 2, and 3) and are presented in Table D.5-2. It does not include exposure to external radiation emanating from radionuclides in surface soils. These later risk are accounted for in the nuclide-specific ILCR.

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for each receptor by exposure scenario. Table 7-1 provides risk estimates for the current and future land-use scenarios without access controls for both the current and future source-term scenario, and for the current land-use scenario with access controls for the current source-term scenario. The largest reported radiological risk values are associated with the future land-use/future source-term scenario. Table 7-2 provides the HIs for noncarcinogenic constituents for each receptor by exposure scenario.

Of the scenarios presented, the current land use with access controls/current source-term scenario most closely approximates current conditions at the FEMP site. However, conservative assumptions were made, consistent with those made for other scenarios, to ensure that the calculated baseline risk represents an upper bound. Under this scenario, the receptor with the largest radiological risk (5×10^{-3}) is the trespassing child. The maximum contributor to the calculated risk is exposure to external radiation while on top of the Silo 1 or 2 dome. Under this scenario, the receptor with the largest chemical risk (1×10^{-4}) is the off-property resident farmer. The constituent providing the maximum contribution to this risk value is indeno(1,2,3-cd)pyrene through meat and milk exposure routes from soil subject to deposition from air. The total radiological plus chemical calculated risk under this scenario for the off-property resident farmer is 1×10^{-4} and for the trespassing child is 5×10^{-3}.

None of the HIs under this scenario exceeded 1.0. The highest is 0.3 (Table 7-2) for the trespassing child and is due primarily to antimony, chromium, cobalt, manganese, and uranium in soil.

Of the remaining scenarios in Tables 7-1 and 7-2, the future land-use/future source-term scenario represents the most conservative scenario considered under the risk assessment. Within this scenario, a family is assumed to have established a residence within the Operable Unit 4 boundaries. Additionally, the domes of Silos 1 and 2 are assumed to have failed and Silo 3 is assumed to have suffered total structural failure, spreading its contents on the surface of Operable Unit 4.

Under this scenario, the receptor with the largest radiological risk (approaching unity [1]) is the RME on-property resident farmer. The maximum contributors to the calculated risk are Ra-226 and Th-228 in soil through the external radiation exposure route. Under this scenario, the receptor with the largest chemical risk (2×10^{-1}) is also the RME on-property resident farmer. The maximum contributors to the calculated risk are ingestion of arsenic and indeno(1,2,3-cd)pyrene through meat and milk exposure routes from soil. The total risk to the RME on-property resident farmer is estimated to exceed unity and is due primarily to the radiological risk associated with external radiation exposure from Ra-226 and Th-228 in soil.

The highest HI (2000) under this scenario is to the on-property resident child and is due primarily to ingestion of soil and foodstuffs and dermal contact with soil materials containing arsenic.

TABLE D.3-1 5357

PARAMETERS USED TO ESTIMATE POTENTIAL EXPOSURES FOR CURRENT LAND USE RECEPTORS[a]

Pathway Parameters	Trespassing Child Age 7-18	Groundskeeper Worker	Off-property Resident Farmer Age 1-70	Off-property User of Surface Water Age 1-70
Inhalation of VOCs, Fugitive Dust, and Radon				
IR (m^3/hr)	0.83[b]	0.83[b]	0.83[b]	NA[c]
ET (hr/d)	4[d]	8[e]	5.7[f]	NA
EF (d/yr)	52[d]	35[e]	350[g]	NA
ED (yr)	12	25[g]	70	NA
BW (kg)	43	70	70	NA
AT-Noncancer (d)[h]	4380	9125	25550	NA
AT-Cancer (d)[i]	25550	25550	25550	NA
Incidental Ingestion of Soil/Sediment				
IR (g/d)	0.1	0.050[g]	NA	NA
FI	0.25[j]	1[g]	NA	NA
EF (d/yr)	52[d]	35[e]	NA	NA
ED (yr)	12	25[g]	NA	NA
BW (kg)	43	70	NA	NA
AT-Noncancer (d)[h]	4380	9125	NA	NA
AT-Cancer (d)[i]	25550	25550	NA	NA
Dermal Contact with Soil/Sediment				
SA (m^2)	0.42[k]	0.58[k]	NA	NA
AF (mg/cm^2)	1.0[k]	1.0[k]	NA	NA
ABS (unitless)	csv[l]	csv	NA	NA
EF (d/yr)	52[d]	35[e]	NA	NA
ED (yr)	12	25[g]	NA	NA
BW (kg)	43	70	NA	NA
AT-Noncancer (d)[h]	4380	9125	NA	NA
AT-Cancer (d)[i]	25550	25550	NA	NA
External Radiation Exposure				
DR (mrem/hr)	csv	csv	NA	NA
ET indoors (hr/d)	NA	NA	NA	NA
ET outdoors (hr/d)	4[d]	8[e]	NA	NA
EF (d/yr)	52[d]	35[e]	NA	NA
ED (yr)	12	25[g]	NA	NA
SH indoors (unitless)	NA	NA	NA	NA

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TABLE D.3-11
(Continued)

Pathway Parameters	Trespassing Child Age 7-18	Groundskeeper Worker	Off-property Resident Farmer Age 1-70	Off-property User of Surface Water Age 1-70
SH outdoors (unitless)	0	0	NA	NA
Incidental Ingestion of Surface Water				
IR (L/hr)	0.05[m]	NA	NA	NA
ET (hr/d)	1[n]	NA	NA	NA
EF (d/yr)	52[d]	NA	NA	NA
ED (yr)	12	NA	NA	NA
BW (kg)	43	NA	NA	NA
AT-Noncancer (d)[h]	4380	NA	NA	NA
AT-Cancer (d)[i]	25550	NA	NA	NA
Dermal Contact with Surface Water				
SA (m^2)	0.96[o]	NA	NA	NA
PC (cm/hr)	csv	NA	NA	NA
ET (hr/d)	1.0[n]	NA	NA	NA
EF (d/yr)	52[d]	NA	NA	NA
ED (yr)	12	NA	NA	NA
BW (kg)	43	NA	NA	NA
AT-Noncancer (d)[h]	4380	NA	NA	NA
AT-Cancer (d)[i]	25550	NA	NA	NA
Drinking Water Ingestion				
IR x FI (L/d)	NA	NA	2	2
EF (d/yr)	NA	NA	350[g]	350[g]
ED (yr)	NA	NA	70	70
BW (kg)	NA	NA	70	70
AT-Noncancer (d)[h]	NA	NA	25550	25550
AT-Cancer (d)[i]	NA	NA	25550	25550
Ingestion of Fruits and Vegetables				
IR (g/d)	NA	NA	122	122
FI (unitless)	NA	NA	1	1
EF (d/yr)	NA	NA	350[g]	350[g]
ED (yr)	NA	NA	70	70
BW (kg)	NA	NA	70	70
AT-Noncancer (d)[h]	NA	NA	25550	25550
AT-Cancer (d)[i]	NA	NA	25550	25550

TABLE D.3-11
(Continued)

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Pathway Parameters	Trespassing Child Age 7-18	Groundskeeper Worker	Off-property Resident Farmer Age 1-70	Off-property User of Surface Water Age 1-70
Ingestion of Meat, Milk, and Fish				
IR (meat) (g/d)	NA	NA	75	75
IR (milk) (L/d)	NA	NA	0.3	0.3
IR (fish) (g/d)	NA	NA	NA	54
FI (unitless)	NA	NA	NA	1
EF (d/yr)	NA	NA	350[g]	350[g]
ED (yr)	NA	NA	70	70
BW (kg)	NA	NA	70	70
AT-Noncancer (d)[h]	NA	NA	25550	25550
AT-Cancer (d)[i]	NA	NA	25550	25550
Dermal Contact While Bathing				
SA (m^2)	NA	NA	2.30[k]	2.30[k]
PC (cm/hr)	NA	NA	csv	csv
ET (hr/d)	NA	NA	0.25[k]	0.25[k]
EF (d/yr)	NA	NA	350[g]	350[g]
ED (yr)	NA	NA	70	70
BW (kg)	NA	NA	70	70
AT-Noncancer (d)[h]	NA	NA	25550	25550
AT-Cancer (d)[i]	NA	NA	25550	25550
Inhalation of Volatiles Released from Household Water Use				
IR (m^3/d)	NA	NA	15[g]	15[g]
EF (d/yr)	NA	NA	350[g]	350[g]
ED (yr)	NA	NA	70	70
BW (kg)	NA	NA	70	70
AT-Noncancer (d)[h]	NA	NA	25550	25550
AT-Cancer (d)[i]	NA	NA	25550	25550

[a] Parameter values obtained from the Risk Assessment Work Plan Addendum (DOE 1992a) unless otherwise noted.
[b] Derived by dividing the default adult human inhalation rate of 20 m^3/day (EPA, 1989a, Risk Assessment Guidance for Superfund) by 24 hours/day, and rounding to two significant figures.
[c] NA = Not applicable.
[d] Specific guidance from EPA Region 5 (9/30/92 EPA comments on Sitewide Characterization Report): standard trespass scenario assumes 4 hr/d, 52 d/yr [three days/week during June, July, and August when not in school (36 days), and one day/week during April, May, September, and October (16 days)].
[e] Assumes the worker is a groundskeeper, who works 8 hours/day, 1 day/week 35 weeks/year on the grounds of Operable Unit 4.

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TABLE D.3-11
(Continued)

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[f] Special guidance from EPA Region V (Teleconference between P. VanLeeuwen, EPA Region V, and M. Bollenbacher, IT Corp., 2/25/93); 8 hours/day spent outdoors for 250 days/year = 2000 hours/year; this value divided by 350 days/year on site = 5.7 hours/day spent outdoors.

[g] EPA (1991b, Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual, Supplemental Guidance, "Standard Default Exposure Factors", Interim Final, OSWER Directive: 9285.6-03.

[h] Calculated as the product of ED (years) x 365 days/year.

[i] Calculated as the product of 70 years (assumed lifetime) x 365 days/year.

[j] Assumes a small child spends 4 of 16 waking hours/day on site.

[k] EPA (1992e), "Dermal Exposure Assessment: Principals and Applications, EPA/600/8-91/011B

[l] csv = Chemical-specific value (ABS and PC values located in Table D.3-14, DR values are located in Table D.3-15).

[m] EPA (1989a), "Risk Assessment Guidance for Superfund Vol. I, Human Health Evaluation Manual (Part A)."

[n] Differs from this parameter for other exposure pathways because the receptor is not expected to play in water all the time he is on site.

[o] See Section D.3.3.4.

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TABLE D.3-12

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PARAMETERS USED TO ESTIMATE POTENTIAL EXPOSURES FOR FUTURE LAND USE RECEPTORS[a]

Pathway Parameters	Off-property User of Surface Water Age 1-70	CT On-property Resident Farmer Age 1-70	RME On-property Resident Farmer Age 1-70	Off-property Resident Farmer Age 1-70	On-property Resident Child Age 1-6
Inhalation of Dusts, Volatiles, and Radon					
IR (m^3/hr)	NA[b]	0.83[c]	0.83[c]	0.83[c]	2.0[d]
ET Indoors (hr/d)	NA	19.8[e]	18.3[f]	18.3[f]	22[g]
ET Outdoors (hr/d)	NA	4.2[e]	5.7[f]	5.7[f]	2[g]
EF (d/yr)	NA	275[e]	350[h]	350[h]	350[h]
ED (yr)	NA	9[h]	70	70	6
BW (kg)	NA	70	70	70	15
AT-Noncancer (d)[i]	NA	3285	25550	25550	2190
AT-Cancer (d)[j]	NA	25550	25550	25550	25550
Ingestion of Drinking Water					
IR (ℓ/d)	2	1.4[e]	2	2	1.4
FI (unitless)	1	1	1	1	1
EF (d/yr)	350[h]	275[e]	350[h]	350[h]	350[h]
ED (yr)	70	9[h]	70	70	6
BW (kg)	70	70	70	70	15
AT-Noncancer (d)[i]	25550	3285	25550	25550	2190
AT-Cancer (d)[j]	25550	25550	25550	25550	25550
Inhalation of Volatiles Released from Household Water Uses					
IR (m^3/d)	15[h]	15[h]	15[h]	15[h]	15[h]
EF (d/yr)	350[h]	275[e]	350[h]	350[h]	350[h]
ED (yr)	70	9[h]	70	70	6
BW (kg)	70	70	70	70	15
AT-Noncancer (d)[i]	25550	3285	25550	25550	2190
AT-Cancer (d)[j]	25550	25550	25550	25550	25550
Dermal Contact While Bathing					
SA (m^2)	2.3[k]	2.0[k]	2.3[k]	2.3[k]	0.8[k]
PC (cm/hr)	csv[l]	csv	csv	csv	csv
ET (hr/d)	0.25[k]	0.17[k]	0.25[k]	0.25[k]	0.25[k]
EF (d/yr)	350[h]	275[e]	350[h]	350[h]	350[h]
ED (yr)	70	9[h]	70	70	6
BW (kg)	70	70	70	70	15
AT-Noncancer (d)[i]	25550	3285	25550	25550	2190
AT-Cancer (d)[j]	25550	25550	25550	25550	25550

TABLE D.3-12
(Continued)

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Pathway Parameters	Off-property User of Surface Water Age 1-70	CT On-property Resident Farmer Age 1-70	RME On-property Resident Farmer Age 1-70	Off-property Resident Farmer Age 1-70	On-property Resident Child Age 1-6
Incidental Ingestion of Soil/Sediment					
IR (g/d)	NA	0.122[e]	0.18[e]	NA	0.2
FI	NA	1[m]	1[m]	NA	1[m]
EF (d/yr)	NA	275[e]	350[h]	NA	350[h]
ED (yr)	NA	9[h]	70	NA	6
BW (kg)	NA	70	70	NA	15
AT-Noncancer (d)[i]	NA	3285	25550	NA	2190
AT-Cancer (d)[j]	NA	25550	25550	NA	25550
Dermal Contact with Soil/Sediment					
SA (m^2)	NA	0.5[k]	0.58[k]	NA	0.2[k]
AF (mg/cm^2)	NA	0.2[k]	1.0[k]	NA	1.0[k]
ABS (unitless)	NA	csv	csv	NA	csv
EF (d/yr)	NA	48[e]	350[h]	NA	350[h]
ED (yr)	NA	9[h]	70	NA	6
BW (kg)	NA	70	70	NA	15
AT-Noncancer (d)[i]	NA	3285	25550	NA	2190
AT-Cancer (d)[j]	NA	25550	25550	NA	25550
External Radiation Exposure					
DR (mrem/hr)	NA	csv	csv	NA	csv
ET Indoors (hr/d)	NA	19.8[e]	18.3[f]	NA	22[g]
ET Outdoors (hr/d)	NA	4.2[e]	5.7[f]	NA	2[g]
EF (d/yr)	NA	275[e]	350[h]	NA	350[h]
ED (yr)	NA	9[h]	70	NA	6
SH Indoors (unitless)	NA	0.5	0.5	NA	0.5
SH Outdoors (unitless)	NA	0	0	NA	0
Ingestion of Vegetables and Fruit					
IR (g/d)	122	78[e]	122	122	101.5
FI (unitless)	1	1	1	1	1
EF (d/yr)	350[h]	275[e]	350[h]	350[h]	350[h]
ED (yr)	70	9[h]	70	70	6
BW (kg)	70	70	70	70	15
AT-Noncancer (d)[i]	25550	3285	25550	25550	2190
AT-Cancer (d)[j]	25550	25550	25550	25550	25550
Ingestion of Meat					
IR (g/d)	75	50[e]	75	75	29
FI (unitless)	1	1	1	1	1

TABLE D.3-12
(Continued)

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Pathway Parameters	Off-property User of Surface Water Age 1-70	CT On-property Resident Farmer Age 1-70	RME On-property Resident Farmer Age 1-70	Off-property Resident Farmer Age 1-70	On-property Resident Child Age 1-6
EF (d/yr)	350[h]	275[e]	350[h]	350[h]	350[h]
ED (yr)	70	9[h]	70	70	6
BW (kg)	70	70	70	70	15
AT-Noncancer (d)[i]	25550	3285	25550	25550	2190
AT-Cancer (d)[j]	25550	25550	25550	25550	25550
Ingestion of Milk					
IR (L/d)	0.3	0.2[e]	0.3	0.3	0.9
FI (unitless)	1	1	1	1	1
EF (d/yr)	350[h]	275[e]	350[h]	350[h]	350[h]
ED (yr)	70	9[h]	70	70	6
BW (kg)	70	70	70	70	15
AT-Noncancer (d)[i]	25550	3285	25550	25550	2190
AT-Cancer (d)[j]	25550	25550	25550	25550	25550
Ingestion of Fish					
IR (g/d)	54	NA	NA	NA	NA
FI (unitless)	1	NA	NA	NA	NA
EF (d/yr)	350[h]	NA	NA	NA	NA
ED (yr)	70	NA	NA	NA	NA
BW (kg)	70	NA	NA	NA	NA
AT-Noncancer (d)[i]	25550	NA	NA	NA	NA
AT-Cancer (d)[j]	25550	NA	NA	NA	NA
Incidental Ingestion of Surface Water During Swim or Play					
IR (L/hr)	NA	NA	NA	NA	0.05[n]
FI (unitless)	NA	NA	NA	NA	1
ET (hr/d)	NA	NA	NA	NA	0.5[k]
EF (d/yr)	NA	NA	NA	NA	5[k]
ED (yr)	NA	NA	NA	NA	6
BW (kg)	NA	NA	NA	NA	15
AT-Noncancer (d)[i]	NA	NA	NA	NA	2190
AT-Cancer (d)[j]	NA	NA	NA	NA	25550
Dermal Contact with Surface Water During Swim or Play					
SA (m^2)	NA	NA	NA	NA	0.8[k]
PC (cm/hr)	NA	NA	NA	NA	csv
ET (hr/d)	NA	NA	NA	NA	0.5[k]
EF (d/yr)	NA	NA	NA	NA	5[k]
ED (yr)	NA	NA	NA	NA	6

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TABLE D.3-12
(Continued)

Pathway Parameters	Off-property User of Surface Water Age 1-70	CT On-property Resident Farmer Age 1-70	RME On-property Resident Farmer Age 1-70	Off-property Resident Farmer Age 1-70	On-property Resident Child Age 1-6
BW (kg)	NA	NA	NA	NA	15
AT-Noncancer (d)[i]	NA	NA	NA	NA	2190
AT-Cancer (d)[j]	NA	NA	NA	NA	25550

[a] Parameter values obtained from the Risk Assessment Work Plan Addendum (DOE 1992a) unless otherwise noted.
[b] NA = Not applicable.
[c] Derived by dividing the default adult human inhalation rate of 20 m^3/day (EPA 1989a, Risk Assessment Guidance for Superfund) by 24 hours/day, and rounding to two significant figures.
[d] Exposure Factors Handbook (EPA 1990e) p. 3-4; Inhalation rate for "moderate" activity for a 6-year old child.
[e] Special guidance from EPA Region V for the CT scenario (Teleconferences between P. VanLeeuwen, EPA Region V, and M. Bollenbacher, IT Corp., 12/3/93 and 12/7/93) drinking water ingestion rate = 1.4 L/day; EF = 275 days/year; vegetable and fruit ingestion = 78 g/day; meat ingestion = 50 g/day; milk ingestion = 0.2 L/day; soil ingestion rate = 122 mg/day; dermal contact with soil = 48 days/year; hours/day spent indoors and outdoors = 19.8 and 4.2, respectively.
[f] Special guidance from EPA Region V (Teleconference between P. VanLeeuwen, EPA Regon V, and M. Bollenbacher, IT Corp., 2/25/93); 8 hours/day spent outdoors for 250 days/year = 2000 hours/year; this value divided by 350 days/year on-site = 5.7 hours/day spent outdoors; 18.3 hours/day spent indoors determined by difference.
[g] Assumes a resident small child spends 2 hours/day outdoors x 350 days/year for a total of 700 hours/year on site; 22 hours/day indoors determined by difference.
[h] EPA 1991b, "Risk Assessment Guidance for Superfund Vol. I: Human Health Evaluation Manual Supplemental Guidance, 'Standard Default Exposure Factors'," Interim Final, OSWER Directive: 9285.6-03.
[i] Calculated as the product of ED (years) x 365 days/year.
[j] Calculated as the product of 70 years (assumed lifetime) x 365 days/year.
[k] EPA 1992e, "Dermal Exposure Assessment: Principals and Applications," EPA/600/8-91/001B.
[l] csv = Chemical-specific value: PC and ABS from Table D.3-14; DR from Table D.3-15.
[m] Assumed value, based on fraction of day spent on site.
[n] EPA 1989a, Risk Assessment Guidance for Superfund.
[o] See explanation in Section D.3.3.1.

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TABLE D.3-14

DERMAL ABSORPTION COEFFICIENTS AND HENRY'S LAW CONSTANTS USED IN EXPOSURE MODEL

Constituent	Water Permeability Coefficient (cm/hr)	Soil Absorption Coefficient (unitless)	Henry's Law Constant (atm-m^3/mol)	Log K_{ow}
Inorganics				
Ammonia	1.00×10^{-3}[a]	1.00×10^{-2}[b]	ND	ND
Antimony	1.00×10^{-3}[a]	1.00×10^{-2}[b]	ND	ND
Arsenic	1.00×10^{-3}[a]	1.00×10^{-3}[b]	ND	ND
Barium	1.00×10^{-3}[a]	1.00×10^{-2}[b]	ND	ND
Beryllium	1.00×10^{-3}[a]	1.00×10^{-2}[b]	ND	ND
Boron	1.00×10^{-3}[a]	1.00×10^{-2}[b]	ND	ND
Cadmium (food)	1.00×10^{-3}[c]	1.00×10^{-2}[b]	ND	ND
Chromium	2.00×10^{-3}[c]	1.00×10^{-2}[b]	ND	ND
Cobalt	4.00×10^{-4}[c]	1.00×10^{-2}[b]	ND	ND
Cyanide	1.00×10^{-3}[a]	ND[b]	ND	ND
Copper	1.00×10^{-3}[a]	1.00×10^{-3}[b]	ND	ND
Fluoride	1.00×10^{-3}[a]	1.00×10^{-2}[b]	ND	ND
Lead	4.00×10^{-6}[c]	1.00×10^{-2}[b]	ND	ND
Manganese	1.00×10^{-3}[a]	1.00×10^{-2}[b]	ND	ND
Mercury	1.00×10^{-3}[c]	5.00×10^{-2}[b]	ND	ND
Molybdenum	1.00×10^{-3}[a]	1.00×10^{-2}[b]	ND	ND
Nickel	1.00×10^{-4}[c]	5.00×10^{-4}[b]	ND	ND
Nitrate	ND	ND	ND	ND
Phosphorous	ND	1.00×10^{-1}[b]	ND	ND
Selenium	1.00×10^{-3}[a]	1.00×10^{-2}[b]	ND	ND
Silver	6.00×10^{-4}[c]	1.00×10^{-2}[b]	ND	ND
Thallium	1.00×10^{-3}[a]	1.00×10^{-2}[b]	ND	ND
Uranium	1.00×10^{-3}[a]	1.00×10^{-2}[b]	ND	ND
Vanadium	1.00×10^{-3}[a]	1.00×10^{-3}[b]	ND	ND
Zinc	6.00×10^{-4}[c]	1.00×10^{-2}[b]	ND	ND

TABLE D.3-14
(Continued)

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Constituent	Water Permeability Coefficient (cm/hr)	Soil Absorption Coefficient (unitless)	Henry's Law Constant (atm-m^3/mol)	Log K_{ow}
Volatile Organics				
2-Butanone	1.10×10^{-3}[c]	5.00×10^{-4}[b]	2.74×10^{-5}[d]	0.29[c]
2-Hexanone	4.45×10^{-3}[g]	3.00×10^{-1}[b]	ND	1.38[f]
4-Methyl-2-pentanone	ND	3.00×10^{-1}[b]	ND	ND
Acetone	5.70×10^{-4}[g]	5.00×10^{-4}[b]	2.06×10^{-5}[d]	-0.24[f]
Carbon tetrachloride	2.40×10^{-2}[e]	4.00×10^{-1}[b]	2.93×10^{-2}[f]	2.83[e]
Methylene chloride	4.10×10^{-3}[e]	4.00×10^{-1}[b]	3.19×10^{-3}[f]	1.25[e]
Tetrachloroethene	5.30×10^{-2}[e]	4.00×10^{-1}[b]	2.87×10^{-2}[f]	3.40[e]
Toluene	4.50×10^{-2}[c]	3.00×10^{-2}[b]	5.92×10^{-3}[f]	2.73[c]
Total xylenes	8.00×10^{-2}[c]	3.00×10^{-2}[b]	5.27×10^{-3}[f]	3.20[c]
Semivolatile Organics				
Acenaphthylene	1.74×10^{-1}[g]	3.00×10^{-1}[b]	1.14×10^{-4}[f]	4.07[f]
Anthracene	2.25×10^{-1}[g]	4.00×10^{-1}[b]	8.60×10^{-3}[f]	4.45[f]
Benzo(g,h,i)perylene	5.34×10^{0}[g]	3.00×10^{-1}[b]	5.34×10^{-8}[d]	7.23[f]
Benzoic acid	7.10×10^{-3}[e]	3.00×10^{-1}[b]	ND	1.87[e]
bis(2-Ethylhexyl)phthalate	4.58×10^{-2}[g]	4.00×10^{-3}[b]	3.00×10^{-7}[f]	5.3[f]
Di-n-butylphthalate	3.90×10^{-2}[e]	3.00×10^{-1}[b]	2.80×10^{-7}[f]	4.13[e]
Di-n-octylphthalate	2.69×10^{1}[g]	3.00×10^{-1}[b]	ND	9.2[f]
Diethyl phthalate	5.00×10^{-3}[e]	3.00×10^{-1}[b]	1.14×10^{-6}[d]	2.47[e]
Dimethyl phthalate	1.60×10^{-3}[e]	3.00×10^{-1}[b]	ND	1.56[e]
Fluoranthene	4.50×10^{-1}[e]	3.00×10^{-1}[b]	6.50×10^{-6}[f]	4.95[e]
2-Nitrophenol	4.90×10^{-3}[e]	ND	1.79[f]	1.79[e]
4-Nitrophenol	6.00×10^{-3}[e]	3.00×10^{-1}[b]	1.91[f]	1.91[e]
N-Nitroso-di-n-propylamine	2.61×10^{-3}[g]	3.00×10^{-1}[b]	ND	1.31[f]
Phenanthrene	2.70×10^{-1}[e]	3.00×10^{-1}[b]	3.93×10^{-5}[f]	4.46[e]
Phenol	5.20×10^{-3}[e]	3.00×10^{-1}[b]	1.30×10^{-6}[f]	1.46[e]
Pyrene	5.30×10^{-1}[g]	3.00×10^{-1}[b]	5.10×10^{-6}[f]	5.18[f]
Tributyl phosphate	3.13×10^{-2}[g]	3.00×10^{-1}[b]	ND	4.00[f]

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TABLE D.3-14
(Continued)

Constituent	Water Permeability Coefficient (cm/hr)	Soil Absorption Coefficient (unitless)	Henry's Law Constant (atm-m^3/mol)	Log K_{ow}
Pesticide/PCBs				
Aldrin	1.70×10^{-3}[e]	3.00×10^{-1}[b]	4.96×10^{-4}[f]	3.01[e]
Aroclor-1248	1.80×10^{0}[e]	3.00×10^{-1}[b]	4.40×10^{-4}[f]	5.75[f]
Aroclor-1254	1.00×10^{0}[e]	3.00×10^{-1}[b]	8.37×10^{-3}[f]	6.03[f]
Aroclor-1260	1.00×10^{0}[e]	3.00×10^{-1}[b]	3.36×10^{-4}[f]	6.11[f]
4,4'-DDE	3.20×10^{-1}[e]	3.00×10^{-1}[b]	6.80×10^{-5}[f]	5.69[e]
4,4'-DDT	6.00×10^{-1}[e]	3.00×10^{-1}[b]	3.89×10^{-5}[f]	6.36[e]
Dieldrin	1.90×10^{-2}[e]	3.00×10^{-1}[b]	5.84×10^{-5}[f]	4.56[e]
Endosulfan I	2.08×10^{-3}[g]	3.00×10^{-1}[b]	ND	3.55[f]
Endosulfan II	2.33×10^{-3}[g]	3.00×10^{-1}[b]	ND	3.62[f]
Endrin	1.90×10^{-2}[e]	3.00×10^{-1}[b]	4.00×10^{-7}[f]	4.56[e]
Heptachlor epoxide	6.65×10^{-4}[g]	3.00×10^{-1}[b]	3.16×10^{-5}[f]	2.70[d]

ND = No data
[a]EPA, 1992e, Page 5-38, the default value for inorganics is 1×10^{-3}, the experimental value for cadmium.
[b]EPA 1993b, Memorandum from J. Dollarhide ECAO to P. VanLeeuwen Region V, 7/21/93, including Attachments 1-6.
[c]EPA, 1992e, Dermal Exposure Assessment: Principles and Applications.
[d]Superfund Public Health Evaluation Manual, October 1986, (SPHEM) (EPA, 1986a).
[e]EPA, 1992g, Supplemental Guidance for Dermal Risk Assessment.
[f]EPA, 1991c, Werl Treatability Database.
[g]Estimated using the regression equation: $\text{Log } K_p = -2.72 + 0.71 \log K_{ow} - 0.0061 \text{ MW}$.

Calculation of potential intakes of contaminants is discussed in Section D.3.3. Calculated intakes are not presented because this is an interim step to risk characterization. The URFs that incorporate calculation of exposure intakes are presented in Attachment D.I. The models (and formulae) used for intake calculations are generally accepted as the most appropriate for an exposure assessment. Specific model parameters were selected to provide reasonable, upper bound estimates of intake. Discussions of the appropriateness of selected parameters are given in numerous references cited in the Work Plan Addendum (DOE 1992a). It can be concluded, however, that the selected parameters as a whole will lead to overestimates, rather than underestimates, of the potential intakes by hypothetical receptors.

D.3.4 OTHER CONSIDERATIONS

D.3.4.1 Lead

Because toxicity values are not available for lead, and since the final version the EPA uptake biokinetic lead model is not available (see Section D.4.2.11.2), the concentration of lead in soil and sediment is compared to the EPA (1989d, 1991d) cleanup levels of 500-1000 ppm. The concentration of lead in sediment impacted by the sand lens (8400 ppm, Table D.3-4) and for soil, future source term (2400 ppm, Table D.3-5) exceeds these cleanup levels. Lead was not identified as a CPC in contaminated soil, current source term (Table D.3-6).f

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TABLE D.5-2

CALCULATED ILCRs FROM EXTERNAL RADIATION EXPOSURE FROM THE SILOS UNDER THE CURRENT SOURCE-TERM SCENARIO

Location	Trespassing Child	Groundskeeper	CT On-Property Resident Farmer	RME On-Property Resident Farmer	On-Property Resident Child
Base of Berms Near Silo 1 or 2	0	0	0	0	0
Top of Dome of Silo 1 or 2	**5.4×10^{-3}**	1.5×10^{-2}	2.3×10^{-2}	3.0×10^{-1}	**9.1×10^{-3}**
12 m from Silo 3	7.1×10^{-6}	2.0×10^{-5}	3.0×10^{-5}	4.0×10^{-4}	1.2×10^{-5}
5.9 m from Silo 3	1.5×10^{-5}	4.2×10^{-5}	6.3×10^{-5}	8.4×10^{-4}	2.5×10^{-5}
At Silo 3 Wall	4.4×10^{-5}	**1.2×10^{-4}**	**1.8×10^{-4}**	**2.4×10^{-3}**	7.3×10^{-5}

Note: Although evaluations were made at several locations for each receptor, the bolded values were selected as the subject location for that receptor. Since habits of individuals are difficult to predict, health protective assumptions were made as to the location occupied by individuals. The top of Silos 1 and 2 was assumed for the trespassing child and on-property resident child. This was based on the exploratory nature of children. All other receptors were evaluated at the Silo 3 wall due to the small probability that an adult would spend a significant period of time on the silo domes.

child. Structural failure of the silos is assumed leading to spreading of the metal oxide waste in the Operable Unit 4 Study Area.

For radiological risk, the total radionuclide-related carcinogenic risk for all media is 1×10^{-2}. The most significant medium contribution is from soil. Dominant contributing radionuclides include Ra-226 + 5 dtrs and Th-228 + 7 dtrs. The most significant contributing exposure route is external radiation from soil as shown in Table D.II-2.

The total chemical-related carcinogenic risk for all media is 4×10^{-4}. The transfer medium contributing the highest risk is soil. The B2 PAHs were not responsible for the total ILCR for soil exceeding 1×10^{-4} and were not evaluated by the TEF approach. Other media with significant risk are air, surface water, and sediment. The major contributing chemicals in soil are beryllium and arsenic. Exposure routes of most concern are dermal contact with and incidental ingestion of soil as seen in Table D.II-2. The total chemical plus radiological carcinogenic risk is 1×10^{-2} (Table D.5-4).

The noncarcinogenic hazard is shown in Table D.5-5. The total HI for the receptor is 2×10^{1}; the major contributing transfer medium is air. Contaminated soil contributes significantly as well. The chemicals contributing the most are uranium and arsenic in soil; cobalt in air; and uranium in surface water. Major contributing exposure routes are inhalation, dermal contact with soil, and soil ingestion as presented in Table D.II-4. Individual target organs with HI values greater than 1.0 are the kidney (5), respiratory system (20), and skin (3). The HI for the respiratory system is attributable almost entirely to cobalt. As discussed in Section D.4.2.9.2, however, the relevance of the inhalation RfD (hence the HQ) for environmental exposure to cobalt is doubtful.

D.5.3.1.2 Groundskeeper Worker

This section presents the ILCR and HI results for radionuclide and chemical CPCs for the groundskeeper worker under current land use. Because the presence or absence of access controls would have no effect on exposure frequency, duration or pathways, the groundskeeper worker was evaluated only once, under the scenario without access controls. As with the trespassing child, both the current source-term (silos remain intact) and the future source-term (silo structural failure) conditions are evaluated.

D.5.3.1.2.1 Current Source Term

Table D.5-6 presents the radiological- and chemical-related carcinogenic risks from the two media (air and soil) evaluated for the groundskeeper. This scenario assumes that current source-term conditions prevail, i.e., the silos remain structurally intact.

The total radionuclide-related carcinogenic risk for all media combined is 8×10^{-5}. Of this risk, the primary contributing transfer medium is air. The radionuclide in air contributing the most to risk is