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Retrieval Data Report for Single-Shell Tank 241-C-203

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U.S. Department of Energy Contract DE-AC27-99RL14047

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Abstract: This report describes the retrieval of waste from single-shell tank 241-C-203, which is one of four 200-series single-shell tanks constructed to store waste in Waste Management Area C. The U.S. Department of Energy began retrieval of waste on June 30, 2004, and completed retrieval in compliance with Milestone M-45-00 requirements on March 25, 2005. The limit of the vacuum retrieval system capacity to retrieve waste was reached.

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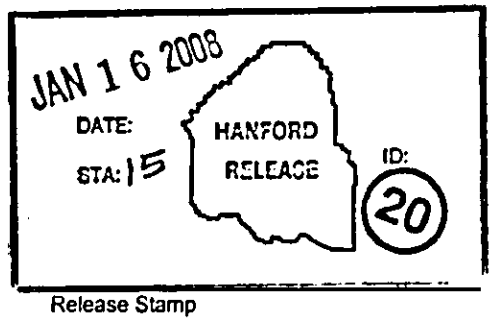

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RETRIEVAL DATA REPORT FOR SINGLE-SHELL TANK 241-C-203

Prepared by
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EXECUTIVE SUMMARY

This Retrieval Data Report (RDR) presents data showing that single-shell tank 241-C-203 (SST C-203) has been retrieved to the limits of the vacuum retrieval system (VRS) technology and that tank waste residuals in SST C-203 do not exceed 30 ft^3. These achievements satisfy the tank waste retrieval criteria established by Milestone M-45-00 of the *Hanford Federal Facility Agreement and Consent Order* (HFFACO). This RDR also summarizes the potential risk to human health from waste remaining in the tank, provides details on the VRS technology and its performance in the SST C-203 retrieval campaign, and describes measures taken to prevent and detect leaks during retrieval.

The SST C-203 retrieval campaign began June 30, 2004. SST C-203 was retrieved using a VRS, which used vacuum pumps to mobilize and remove waste from the tank. Use of this system minimized both the need to add water to the tank and the in-tank pooling of liquids. Removed waste was diluted with raw water and transferred to double-shell tank 241-AN-106 (DST AN-106).

The SST C-203 leak detection, monitoring, and mitigation program used during retrieval focused on a mitigation strategy to control potential leaks. Based on the available data, there was no evidence of a tank leak occurring during SST C-203 retrieval operations. A minor (30 mL) water leak that occurred in equipment located on a skid was contained and mitigated.

On March 24, 2005, representatives of the U.S. Department of Energy (DOE) and CH2M HILL Hanford Group, Inc. (CH2M HILL) determined that the technical limit of the VRS to retrieve waste from SST C-203 had been reached and briefed the Washington State Department of Ecology. In determining that the VRS's capacity to remove waste from SST C-203 had been reached, DOE and CH2M HILL relied on the following:

a. Decreases over time in the specific gravity of the recovered waste stream.
b. Direct visual observation of the waste remaining in the tank bottom.
c. Analysis of retrieval data on the ratio of water used to waste retrieved.
d. Volume of residual waste at the end of each operating day.

Subsequent measurement of the residual waste in SST C-203 using topographical mapping and survey techniques in accordance with Attachment 1 to HFFACO Appendix H and RPP-23403, *Single-Shell Tank Component Closure Data Quality Objectives*, established that the volume of waste remaining in SST C-203 was 18.5 ft^3, with an upper confidence level of 19.9 ft^3.

SST C-203 held approximately 2,640 gal (353 ft^3) of waste at the start of retrieval. Based on the difference between the starting and ending volume estimates, approximately 2,501 gal (334 ft^3) of waste were retrieved from SST C-203 and transferred to DST AN-106. No leaks from SST C-203 were detected during retrieval operations.

The inventory of constituents in the SST C-203 residual waste was determined by laboratory analysis of waste samples taken after the completion of retrieval. The risk assessment for the residual waste in SST C-203 based on sampling analyses shows that the estimated Incremental Lifetime Cancer Risk, Hazard Index, all pathways farmer dose, and target organ dose are two to four orders of magnitude below the performance objectives prescribed for closure of the Waste Management Area C, which includes SST C-203. For the inadvertent intruder scenarios, the suburban garden scenario is approximately three times above the performance objective for the nominal and 95% upper confidence level (UCL) inventories at 100 years after closure. At

500 years after closure, all inadvertent intruder scenarios are at least a factor of 25 below the performance objectives for the nominal inventory and a factor of approximately 14 below performance objectives for the 95% UCL inventory.

DOE has no recommendations for additional retrieval actions at SST C-203 because Milestone M-45-00 retrieval criteria have been satisfied, and retrieval is complete.

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Table 8-1. Estimated Maximum Incremental Lifetime Cancer Risk/Radiological Dose During the Modeling Period for Primary Radionuclides.

Analyte	Detect[a]	Inventory (Ci)	WMA C Fence Line Concentration (pCi/L)	Peak Year	K_d (mL/g)[b]	Half-Life (yr)	Incremental Lifetime Cancer Risk Scenarios (Groundwater)		Radiological Dose Groundwater (mrem/yr)	Radiological Dose Beta/Photon (mrem/yr)
							Industrial[c]	Residential[c]	All Pathway Farmer[c]	Drinking Water MCL[c]
^{99}Tc	S	2.56E-03	1.02E-02	10461	0	211,097	1.41E-10	3.43E-09	1.79E-05	4.54E-05
^{129}I	S	1.62E-05	<0.001	12032	0.2	15,700,000	C/A	C/A	C/A	C/A
^{234}U	S	1.24E-01	0	DNA	0.6	245,694	0	0	0	N/A
$^{235}U + D$	S	5.27E-03	0	DNA	0.6	703,700,000	0	0	0	N/A
^{236}U	S	9.17E-04	0	DNA	0.6	23,420,000	0	0	0	N/A
$^{238}U + D$	S	1.20E-01	0	DNA	0.6	4,468,000,000	0	0	0	N/A
^{14}C	U	4.39E-04	<0.001	9781	0	5,730	C/A	C/A	C/A	C/A
^{233}U	U	3.49E-02	0	DNA	0.6	159,198	0	0	0	N/A
Performance objective[d]							1-0E-6 to 1.0E-4[e]	1-0E-6 to 1.0E-4[e]	25[f]	4[g]

[a] U indicates analyte was not detected in sludge. S indicates analyte was detected in the sludge.
[b] See PNNL-13895, *Hanford Contaminant Distribution Coefficient Database and Users Guide*, Rev. 1, for the basis for the K_d values listed for the radionuclides.
[c] All exposure scenarios are described in HNF-SD-WM-TI-707.
[d] Performance objectives apply to the cumulative (i.e., all contaminants) for the entire WMA.
[e] EPA/540/R-99/006, *Radiation Risk Assessment at CERCLA Sites: Q & A, Directive* 9200.4-31P.
[f] DOE O 435.1, *Radioactive Waste Management.*
[g] 65 FR 76708, "National Primary Drinking Water Regulations; Radionuclides; Final Rule."

C/A = constituent analyzed, but this risk metric was not calculated because the radioactive analyte was predicted to have a concentration less than 0.001 pCi/L, which is well below the ability of standard laboratory analytical methods to detect it.
DNA = did not arrive at fenceline at a concentration greater than 0.001 pCi/L within the 10,000 year modeling period.
MCL = maximum contaminant level.
N/A = radionuclide is not a beta/photon emitter.
NDF = no dose factor.

Table 8-2. Estimated Maximum Value for Incremental Lifetime Cancer Risk and Hazard Quotient per Nonradionuclides. (2 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fence Line Concentration (µg/L)	Peak Year	K_d[b] (mL/g)	Incremental Lifetime Cancer Risk (Groundwater)[c] WAC-173-340 Method B	Hazard Quotient (Groundwater)[c] WAC-173-340 Method B
Chromium	S	2.86E+00	1.2E-02	10481	0	No CPF	3.0E-04
Fluoride	S	1.80E+00	7.4E-03	10481	0	No CPF	7.7E-06
Nitrate	S	4.13E+00	1.7E-02	10481	0	No CPF	6.6E-07
Cobalt	S	2.64E-02	<0.001	12032	0.1	No CPF	C/A
2-Butanone(MEK)	S	7.99E-05	<0.001	10481	0	No CPF	C/A
2-Propanone (Acetone)	S	2.22E-04	<0.001	10481	0	No CPF	C/A
o-Xylene	S	8.24E-06	<0.001	12032	0.02	No CPF	C/A
Tributyl phosphate	S	9.54E+00	<0.001	12032	0.2	C/A	C/A
Xylenes	S	2.02E-05	<0.001	12032	0.02	No CPF	C/A
Acetate $C_2H_3O_2$	S	1.41E-01	<0.001	10481	0	No CPF	No RfD
Nitrite	U	5.47E-01	2.2E-03	10481	0	No CPF	1.4E-06
N-nitroso-di-n-propylamine	U	3.99E-04	<0.001	10481	0	C/A	No RfD
Chloroethene(vinyl chloride)	U	1.72E-06	<0.001	10481	0	C/A	C/A
1, 1, 2-Trichloroethylene	U	4.90E-06	<0.001	12032	0.02	C/A	C/A
Nitrobenzene	U	4.46E-04	<0.001	10481	0	No CPF	C/A
Pyridine	U	3.94E-04	<0.001	10481	0	No CPF	C/A
2-Chlorophenol	U	4.08E-04	<0.001	10481	0	No CPF	C/A
2, 4, 6-Trichlorophenol	U	4.03E-04	<0.001	12032	0.1	C/A	C/A
n-Butyl alcohol (1-butanol)	U	1.72E-03	<0.001	10481	0	No CPF	C/A
Carbon tetrachloride	U	4.57E-06	<0.001	10481	0	C/A	C/A
Performance objective[d]						**1.0E-06[e]**	**1.0[f]**

Notes: See next page.

Table 8-2. Estimated Maximum Value for Incremental Lifetime Cancer Risk and Hazard Quotient per Nonradionuclides. (2 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fence Line Concentration (µg/L)	Peak Year	K_d (mL/g)[b]	Incremental Lifetime Cancer Risk (Groundwater)[c] WAC-173-340 Method B	Hazard Quotient (Groundwater)[c] WAC-173-340 Method B

[a] U indicates analyte was not detected in sludge. S indicates analyte was detected in the sludge.

[b] See PNNL-13895, *Hanford Contaminant Distribution Coefficient Database and Users Guide*, Rev. 1, for the basis for the K_d values listed for chromium and nitrate. The K_d values listed for the organic chemical compounds are determined from the chemicals' organic carbon/water partitioning coefficient and an estimate of 0.03% for the Hanford Site sediments fraction of organic content (PNNL-13895, Rev. 1, page 11, paragraph 3).

[c] All exposure scenarios are described in HNF-SD-WM-TI-707.

[d] Performance objectives apply to entire WMA, not just a single component of the WMA.

[e] *Washington Administrative Code* (WAC) 173-340-705 (2)(c)(ii), "Dangerous Waste Regulations."

[f] WAC 173-340-705 (2)(c)(i).

C/A = constituent analyzed, but this risk metric was not calculated because the nonradioactive analyte was predicted to have a concentration less than 0.001 µg/L, which is well below the ability of standard laboratory analytical methods to detect it.
DNA = did not arrive at fenceline at a concentration greater than 0.001 µg/L within the 10,000 year modeling period.
NDF = no dose factor.
No CPF = no cancer potency factor available.
No RfD = no reference dose available.

8.3 CUMULATIVE ANALYSIS RESULTS FOR TANK C-203 AND WMA C

The cumulative analysis (i. e., sum of the risk metrics) for the SST C-203 residual nominal and 95% UCL risk levels were calculated.

a. **Nominal Inventory**—best estimate of the residual waste inventory computed using mean sample concentrations, mean sample density, and best estimate of the residual volume.

b. **95% Upper Confidence Level Inventory**—considered the bounding inventory. The 95% UCL of the nominal inventory was calculated based on uncertainties associated with the concentration, volume, and density (for solids) measurements (see Section 7.0).

The effects per performance metric associated with each inventory are given in Table 8-3. Two land use scenarios (industrial and residential) were evaluated for HI and ILCR. All effects for both the nominal and 95% UCL inventories were two to four orders of magnitude below the performance objectives.

Table 8-3. Cumulative Incremental Lifetime Cancer Risk, Hazard Index, and Radiological Drinking Water Dose from Peak Groundwater Concentration Related to Residual Waste Volume in SST 241-C-203.

Metric[a]	Industrial Receptor[b]		Residential Receptor[b]		Performance Objective[c]
	Nominal	95% UCL	Nominal	95% UCL	
Radioactive chemicals ILCR (unitless)	1.46E-10	2.51E-10	3.46E-09	5.89E-9	1.0E-06 to 1.0E-4[d]
Nonradioactive chemicals ILCR (unitless)			C/A	C/A	1.0E-5[e]
Hazard Index (unitless)			3.12E-04	4.41E-04	1.0[e]
Dose	**Nominal**		**95% UCL**		**Dose**
APF (mrem/yr)	2.11E-05		3.84E-05		25 mrem/yr[f]
EPA MCL beta/photon emitters (mrem/yr target organ dose)	4.67E-05		8.00E-05		4 mrem/yr[g]
Groundwater Concentration	**Nominal**		**95% UCL**		**MCL**
^{99}Tc (pCi/L)	1.02E-02		1.73E-02		900 pCi/L
^{129}I (pCi/L)	<0.001		<0.001		1 pCi/L
Chromium (mg/L)	1.17E-05		1.65E-05		0.1 mg/L
Uranium (mg/L)	0		0		0.03 mg/L

[a] Metric ILCR-Rad were evaluated using industrial and residential land use scenarios described in HNF-SD-WM-TI-707. ILCR-non-Rad and Hazard Index were evaluated using Method B (residential).
[b] Exposure scenarios from HNF-SD-WM-TI-707.
[c] Performance objectives apply to entire WMA, not just a single component of the WMA
[d] EPA/540/R-99/006, *Radiation Risk Assessment at CERCA Sites: Q & A, Directive 9200.4-31P.*
[e] WAC 173-340-705 (4) and WAC 173-340-706 (4).
[f] DOE O 435.1, *Radioactive Waste Management.*
[g] 65 FR 76708, "National Primary Drinking Water Regulations; Radionuclides; Final Rule."

C/A = constituent analyzed, but this risk metric was not calculated because the nonradioactive analyte was predicted to have a concentration less than 0.001 µg/L, which is well below the ability of standard laboratory analytical methods to detect it.

8.4 INADVERTANT INTRUDER

The DOE recognizes that an inadvertent intruder may be onsite and not be discovered until after exposure has occurred. The radiological dose to an inadvertent intruder is therefore estimated as a part of this risk assessment. The rural farmer with a dairy cow scenario was considered as the reference case in the SST performance assessment (PA), while the suburban garden and commercial farmer scenarios were sensitivity cases in the SST PA.

The dose calculated for each of the intruder scenarios in Table 8-4 are for the nominal and 95% UCL inventories at 100 years and 500 years after closure. At 100 years after closure, the rural pasture, well driller, and commercial farm are approximately 5, 185, and 7,690 times below the performance objectives for the nominal inventory, respectively, and comparably below the performance objectives for the 95% UCL inventory as well. However, the suburban garden scenario is approximately three times above the performance objective for the nominal and 95% UCL inventories. The suburban garden scenario becomes less than the performance objective less than 150 years after closure. At 500 years after closure, all inadvertent intruder scenarios are at least a factor of 25 below the performance objectives for the nominal inventory and a factor of approximately 14 below performance objectives for the 95% UCL inventory. Appendix B contains the inadvertent intruder doses by radionuclide and by internal and external exposure pathways.

Table 8-4. Intruder Dose Summary for Single-Shell Tank C-203.

Intruder Scenario	Nominal Inventory		95 % UCL Inventory	
	100 Years after Closure	500 Years after Closure	100 Years after Closure	500 Years after Closure
Well driller (mrem)	2.7	0.68	3.4	1.1
Rural pasture (mrem/yr)	20.4	0.17	25.2	0.29
Suburban garden (mrem/yr)	289	4.3	359	7.3
Commercial farm (mrem/yr)	0.013	0.0048	0.017	0.0079

Notes:
Site closure is assumed to occur January 1, 2032.
The performance objective for the well driller (acute) is 500 mrem.
The performance objective for all other cases (chronic) is 100 mrem/yr.
Bold intruder scenario indicates reference case used in DOE/ORP-2005-1.

8.5 SUMMARY

This risk assessment is summarized in the following points:

a. The effects estimated for SST C-203, using the nominal inventory, are two to four orders of magnitude below the performance objectives.

b. The following analytes had the most impact per performance metric:

   1. **ILCR-Rad:** ^{99}Tc and ^{14}C contributed 96% and 4%, respectively, of the total for the industrial land use scenario; and for the residential land use scenario, these same

analytes contributed 99% and 1%, respectively. Note that ^{14}C was not detected in the post-retrieval sample and was evaluated at one-half the detection limit.

2. **ILCR-Nonrad:** No detected analyte provided impacts. Of the nondetected analytes, N-nitroso-di-n-propylamine had the largest impact with an ILCR of 1.31E-10, and all other analytes (all nondetected) had ILCR values that were several orders of magnitude below that of N-nitroso-di-n-propylamine.

3. **HI:** Cr^{+6} and fluoride contributed 96.8% and 2.5%, respectively, of the total for the industrial land use scenario; and for the residential land use scenario, these same analytes contributed 96.8% and 2.8%, respectively.

4. **APF:** ^{99}Tc and ^{14}C contributed 84% and 16%, respectively, of the total for the APF.

5. **Drinking Water Dose (Target Organ):** ^{99}Tc and ^{14}C contributed 97% and 3%, respectively, of the total for drinking water dose.

6. **Intruder Dose:** ^{137}Cs, ^{90}Sr, and plutonium isotopes contribute most of the dose in the first 300 years; after that it is plutonium isotopes, uranium isotopes, and ^{237}Np.

c. Table 8-5 provides a comparison of the inventory used in DOE/ORP-2005-01with the inventory calculated from the post-retrieval sample. With the exception of ^{90}Sr and ^{137}Cs, the inventory used in DOE/ORP-2005-01 is either slightly less than the post-retrieval sample inventory.

Table 8-5. Comparison of HTWOS Predicted Inventory used in DOE/ORP-2005-01 and the Nominal Post-Retrieval Inventory.

Analyte	DOE/ORP-2005-01[a] (HTWOS Predicted)	Nominal Post-Retrieval[a]	Ratio of Nominal Inventory/HTWOS
^{99}Tc (Ci)	0.00188	0.00256	1.36
^{90}Sr (Ci)	27.8	244	8.77
^{137}Cs (Ci)	2.02	14	6.93
^{238}Pu (Ci)	0.0492	0.0107	0.22
^{239}Pu (Ci)	1.55	0.535	0.35
^{240}Pu (Ci)	0.334	0.116	0.35
$^{241+D}Pu$ (Ci)	1.77	0.66	0.37
^{241}Am (Ci)	0.0788	0.0333	0.42
Chromium (kg)	16.9	2.86	0.17
Fluoride (kg)	6.8	1.8	0.26
Uranium (kg)	219.0	343	1.57

[a] Inventories for contaminants having the greatest impact for groundwater or inadvertent intruder pathway.

Table A-1. Mean Concentrations and Relative Standard Deviations of Constituents Analyzed in the SST C-203 Residual Waste. (4 sheets)

Constituent Name	CAS	<Detection Limit	Mean	Units	RSD (%)
Lead	7439-92-1		3.34E+03	µg/g	12
Lithium	7439-93-2	<	3.18E+01	µg/g	100
Magnesium	7439-95-4	<	1.59E+02	µg/g	100
Manganese	7439-96-5		5.58E+02	µg/g	16
Mercury	7439-97-6		2.43E+00	µg/g	14
Methylenechloride	75-09-2	<	5.90E-03	µg/g	100
Molybdenum	7439-98-7	<	3.98E+01	µg/g	100
Morpholine, 4-nitroso-	59-89-2	<	1.90E+00	µg/g	100
Naphthalene	91-20-3	<	8.47E-01	µg/g	100
Neodymium	7440-00-8	<	1.59E+02	µg/g	100
^{237}Np	13994-20-2	<	2.15E+01	µg/g	100
Nickel	7440-02-0		2.22E+02	µg/g	22
^{63}Ni-	13981-37-8		6.67E-02	µCi/g	8
Niobium	7440-03-1	<	1.99E+02	µg/g	100
Nitrate	14797-55-8		4.09E+03	µg/g	8
Nitrite	14797-65-0	<	1.08E+03	µg/g	100
Nitrobenzene	98-95-3	<	8.83E-01	µg/g	100
N-Nitroso-di-n-propylamine	621-64-7	<	7.90E-01	µg/g	100
Oxalate	338-70-5	<	1.08E+03	µg/g	100
Palladium	7440-05-3	<	3.98E+02	µg/g	100
Pentachlorophenol	87-86-5	<	6.60E-01	µg/g	100
Percent water	NA		3.55E+01	%	2
Phenol	108-95-2	<	8.13E-01	µg/g	100
Phosphorus	7723-14-0		2.57E+04	µg/g	1
^{238}Pu	13981-16-3	<	2.12E-02	µCi/g	100
$^{239/240}$Pu	NA		6.44E-01	µCi/g	24
Potassium	7440-09-7	<	1.99E+03	µg/g	100
Praseodymium	7440-10-0		1.76E+03	µg/g	2
Pyrene	129-00-0	<	8.47E-01	µg/g	100
Pyridine	110-86-1	<	7.80E-01	µg/g	100
Rhodium	7440-16-6	<	7.96E+02	µg/g	100
Rubidium	7440-17-7	<	1.19E+04	µg/g	100
Ruthenium	7440-18-8	<	2.39E+02	µg/g	100
^{106}Ru/Rb	NA	<	6.41E-01	µCi/g	100
Samarium	7440-19-9	<	7.96E+01	µg/g	100
Selenium	7782-49-2	<	1.99E+02	µg/g	100
^{79}Se	15758-45-9	<	8.41E-04	µCi/g	100
Silicon	7440-21-3		2.19E+03	µg/g	20
Silver	7440-22-4	<	2.39E+01	µg/g	100
Sodium	7440-23-5		6.08E+04	µg/g	2
Strontium	7440-24-6		2.50E+02	µg/g	5
$^{89/90}$Sr	10098-97-2		3.31E+02	µCi/g	8
Sulfide	18496-25-8	<	1.18E+01	µg/g	100
Sulfur	7704-34-9	<	2.39E+02	µg/g	100

Table A-2. Nominal Inventory for SST C-203 Residual Waste. (4 sheets)

Constituent Name	CAS Number	<	Inventory	Inventory Units
^{237}Np	13994-20-2	<	1.53E-02	Ci
Nickel	7440-02-0		2.25E-01	kg
^{63}Ni	13981-37-8		6.74E-02	Ci
Niobium	7440-03-1	<	2.01E-01	kg
Nitrate	14797-55-8		4.13E+00	kg
Nitrite	14797-65-0	<	1.09E+00	kg
Nitrobenzene	98-95-3	<	8.93E-04	kg
N-Nitroso-di-n-propylamine	621-64-7	<	7.99E-04	kg
Oxalate	338-70-5	<	1.09E+00	kg
Palladium	7440-05-3	<	4.02E-01	kg
Pentachlorophenol	87-86-5	<	6.67E-04	kg
Phenol	108-95-2	<	8.22E-04	kg
Phosphorus	7723-14-0		2.60E+01	kg
^{238}Pu	13981-16-3	<	2.14E-02	Ci
^{239}Pu	15117-48-3		5.35E-01	Ci
^{240}Pu	14119-33-6		1.16E-01	Ci
^{241}Pu	14119-32-5		6.60E-01	Ci
Potassium	7440-09-7	<	2.01E+00	kg
Praseodymium	7440-10-0		1.78E+00	kg
Pyrene	129-00-0	<	8.56E-04	kg
Pyridine	110-86-1	<	7.88E-04	kg
Rhodium	7440-16-6	<	8.04E-01	kg
Rubidium	7440-17-7	<	1.21E+01	kg
Ruthenium	7440-18-8	<	2.41E-01	kg
Samarium	7440-19-9	<	8.04E-02	kg
Selenium	7782-49-2	<	2.01E-01	kg
^{79}Se	15758-45-9	<	8.50E-04	Ci
Silicon	7440-21-3		2.21E+00	kg
Silver	7440-22-4	<	2.41E-02	kg
Sodium	7440-23-5		6.15E+01	kg
Strontium	7440-24-6		2.53E-01	kg
$^{89/90}Sr$	10098-97-2		2.44E+02	Ci
Sulfide	18496-25-8	<	1.19E-02	kg
Sulfur	7704-34-9	<	2.41E-01	kg
Tantalum	7440-25-7	<	1.61E-01	kg
^{99}Tc	14133-76-7		2.56E-03	Ci
Tellurium	13494-80-9	<	3.22E-01	kg
Tetrachloroethene	127-18-4	<	6.37E-06	kg
Thallium	7440-28-0	<	4.02E-01	kg
Thorium	7440-29-1		1.93E-02	kg
^{228}Th	14274-82-9		1.04E-05	Ci
^{230}Th	14269-63-7	<	5.80E-03	Ci
^{232}Th	NA		2.09E-06	Ci
Tin	7440-31-5	<	1.61E-01	kg
Titanium	7440-32-6		4.87E-02	kg
Toluene	108-88-3	<	5.92E-06	kg

Table A-3. 95% Upper Confidence Level Inventory for SST C-203 Residual Waste. (4 sheets)

Constituent Name	CAS Number	<	Inventory 95% UL	Inventory Units
Naphthalene	91-20-3	<	2.57E-03	kg
Neodymium	7440-00-8	<	4.83E-01	kg
^{237}Np	13994-20-2	<	4.60E-02	Ci
Nickel	7440-02-0		2.80E-01	kg
^{63}Ni	13981-37-8		7.88E-02	Ci
Niobium	7440-03-1	<	6.04E-01	kg
Nitrate	14797-55-8		4.87E+00	kg
Nitrite	14797-65-0	<	3.28E+00	kg
Nitrobenzene	98-95-3	<	2.68E-03	kg
N-Nitroso-di-n-propylamine	621-64-7	<	2.40E-03	kg
Oxalate	338-70-5	<	3.28E+00	kg
Palladium	7440-05-3	<	1.21E+00	kg
Pentachlorophenol	87-86-5	<	2.00E-03	kg
Phenol	108-95-2	<	2.47E-03	kg
Phosphorus (as phosphate)	7723-14-0		2.85E+01	kg
^{238}Pu	13981-16-3	<	6.87E-02	Ci
Plutonium-239	15117-48-3		7.59E-01	Ci
Plutonium-240	14119-33-6		1.64E-01	Ci
Plutonium-241	14119-32-5		9.37E-01	Ci
Potassium	7440-09-7	<	6.04E+00	kg
Praseodymium	7440-10-0		1.96E+00	kg
Pyrene	129-00-0	<	2.57E-03	kg
Pyridine	110-86-1	<	2.37E-03	kg
Rhodium	7440-16-6	<	2.42E+00	kg
Rubidium	7440-17-7	<	3.63E+01	kg
Ruthenium	7440-18-8	<	7.25E-01	kg
Samarium	7440-19-9	<	2.42E-01	kg
Selenium	7782-49-2	<	6.04E-01	kg
Selenium-79	15758-45-9	<	2.55E-03	Ci
Silicon	7440-21-3		3.00E+00	kg
Silver	7440-22-4	<	7.25E-02	kg
Sodium	7440-23-5		6.79E+01	kg
Strontium	7440-24-6		3.06E-01	kg
Strontium-89/90	10098-97-2		3.01E+02	Ci
Sulfide	18496-25-8	<	3.63E-02	kg
Sulfur (as sulfate)	7704-34-9	<	7.25E-01	kg
Tantalum	7440-25-7	<	4.83E-01	kg
Technetium-99	14133-76-7		4.32E-03	Ci
Tellurium	13494-80-9	<	9.67E-01	kg
Tetrachloroethene	127-18-4	<	1.91E-05	kg
Thallium	7440-28-0	<	1.21E+00	kg
Thorium	7440-29-1	<	1.21E+00	kg
Thorium-228	14274-82-9		3.49E-06	Ci
Thorium-230	14269-63-7	<	1.74E-02	Ci
Thorium-232	NA		3.49E-06	Ci

APPENDIX B

SINGLE-SHELL TANK 241-C-203 TANK RISK DATA

Table B-1. Incremental Lifetime Cancer Risk, Radiological Dose, and Drinking Water Dose per Radionuclide Contaminant of Potential Concern for the Average Inventory. (2 sheets)

Analyte Name	Detect[a]	Inventory (Ci)	WMA C Fenceline Concentration (pCi/L)	Peak Year	K_d (mL/g)[b]	Half-Life (yr)	Incremental Cancer Risk Scenarios (Groundwater)		Radiological Dose Groundwater (mrem/yr)	Radiological Dose Beta/Photon (mrem/yr)
							Industrial[c]	Residential[c]	All-Pathway Farmer[c]	Drinking Water MCL[c]
^{99}Tc	S	2.56E-03	1.02E-02	10461	0	211,097	1.41E-10	3.43E-09	1.79E-05	4.54E-05
^{129}I	S	1.62E-05	<0.001	12032	0.2	15,700,000	C/A	C/A	C/A	C/A
^{63}Ni	S	6.74E-02	0	DNA	5	100.1	0	0	0	0
^{90}Sr +D	S	2.44E+02	0	DNA	5	28.149	0	0	0	0
^{137}Cs + D	S	1.40E+01	0	DNA	5	29.999	0	0	0	0
^{228}Th + D	S	1.04E-05	0	DNA	2	1.9129	0	0	0	N/A
^{232}Th	S	2.09E-06	0	DNA	2	1.405E+10	0	0	0	N/A
^{234}U	S	1.24E-01	0	DNA	0.6	245694	0	0	0	N/A
^{235}U + D	S	5.27E-03	0	DNA	0.6	703,700,000	0	0	0	N/A
^{236}U	S	9.17E-04	0	DNA	0.6	23,420,000	0	0	0	N/A
^{238}U + D	S	1.20E-01	0	DNA	0.6	4.468E+09	0	0	0	N/A
^{239}Pu	S	5.35E-01	0	DNA	2	24,110	0	0	0	N/A
^{240}Pu	S	1.16E-01	0	DNA	2	6,563	0	0	0	N/A
^{241}Pu + D	S	6.60E-01	0	DNA	2	14.35	0	0	0	0
^{241}Am	S	3.33E-02	0	DNA	2	432.7	0	0	0	N/A
^{3}H	U	3.33E-04	0	DNA	0	12.33	0	0	0	0
^{14}C	U	4.39E-04	<0.001	9781	0	5,730	C/A	C/A	C/A	C/A
^{60}Co	U	8.03E-03	0	DNA	0.1	5.2713	0	0	0	0
^{79}Se	U	4.25E-04	0	DNA	2	805,000	0	0	0	N/A
^{125}Sb	U	8.04E-02	0	DNA	1	2.7299	0	0	0	0
^{152}Eu	U	3.77E-02	0	DNA	1	13.33	0	0	0	0
^{154}Eu	U	2.67E-02	0	DNA	1	8.5919	0	0	0	0
^{155}Eu	U	8.31E-02	0	DNA	1	4.68	0	0	0	0
^{230}Th	U	2.90E-03	0	DNA	2	75,380	0	0	0	N/A
^{233}U	U	3.49E-02	0	DNA	0.6	159,198	0	0	0	N/A
^{237}Np	U	7.65E-03	0	DNA	2	2,140,000	0	0	0	N/A

Table B-1. Incremental Lifetime Cancer Risk, Radiological Dose, and Drinking Water Dose per Radionuclide Contaminant of Potential Concern for the Average Inventory. (2 sheets)

Analyte Name	Detect[a]	Inventory (Ci)	WMA C Fenceline Concentration (pCi/L)	Peak Year	K_d (mL/g)[b]	Half-Life (yr)	Incremental Cancer Risk Scenarios (Groundwater)		Radiological Dose Groundwater (mrem/yr)	Radiological Dose Beta/Photon (mrem/yr)
							Industrial[c]	Residential[c]	All-Pathway Farmer[c]	Drinking Water MCL[e]
^{238}Pu	U	1.07E-02	0	DNA	2	87.697	0	0	0	N/A
^{242}Cm	U	2.98E-03	0	DNA	2	0.44611	0	0	0	N/A
^{243}Cm	U	1.19E-04	0	DNA	2	28.499	0	0	0	N/A
^{244}Cm	U	2.86E-03	0	DNA	2	18.1	0	0	0	N/A
Performance Objectives[d]							1-0E-6 to 1.0E-4[e]	1-0E-6 to 1.0E-4[e]	25[f]	4[g]

[a] U indicates analyte was not detected in sludge. S indicates analyte was detected in the sludge.
[b] See PNNL-13895, *Hanford Contaminant Distribution Coefficient Database and Users Guide*, Rev. 1, and Section 4.3 of PNNL-14702, *Vadose Zone Hydrogeology Data Package* for the basis for the K_d values listed for the radionuclides.
[c] All exposure scenarios are described in HNF-SD-WM-TI-707.
[d] Performance objectives apply to the cumulative (i.e., all contaminants) for the entire WMA.
[e] EPA/540/R-99/006, *Radiation Risk Assessment at CERCLA Sites: Q & A, Directive* 9200.4-31P.
[f] DOE O 435.1, *Radioactive Waste Management.*
[g] 65 FR 76708, "National Primary Drinking Water Regulations; Radionuclides; Final Rule."
C/A = constituent analyzed, but this risk metric was not calculated because the radioactive analyte was predicted to have a concentration less than 0.001 pCi/L, which is well below the ability of standard laboratory analytical methods to detect it.
DNA = did not arrive at fenceline at a concentration greater than 0.001 pCi/L within the 10,000 year modeling period.
MCL = maximum contaminant level.
N/A = radionuclide is not a beta/photon emitter.
NDF = no dose factor.

Table B-2. Maximum Value for Incremental Lifetime Cancer Risk and Hazard Index per Nonradionuclide Contaminant of Potential Concern using Average Post-Retrieval Inventory. (5 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fenceline Concentration (µg/L)	Peak Year	K_d (mL/g)[b]	Incremental Lifetime Cancer Risk (Groundwater)[c] WAC-173-340 Method B	Hazard Quotient (Groundwater)[c] WAC-173-340 Method B
Chromium	S	2.86E+00	1.2E-02	10481	0	No CPF	3.0E-04
Fluoride	S	1.80E+00	7.4E-03	10481	0	No CPF	7.7E-06
Nitrate	S	4.13E+00	1.7E-02	10481	0	No CPF	6.6E-07
Cobalt	S	2.64E-02	<0.001	12032	0.1	No CPF	C/A
2-Butanone(MEK)	S	7.99E-05	<0.001	10481	0	No CPF	C/A
2-Propanone (Acetone)	S	2.22E-04	<0.001	10481	0	No CPF	C/A
o-Xylene	S	8.24E-06	<0.001	12032	0.02	No CPF	C/A
Tributyl phosphate	S	9.54E+00	<0.001	12032	0.2	C/A	C/A
Barium	S	5.17E-02	0	DNA	5	No CPF	0
Copper	S	5.28E-02	0	DNA	5	No CPF	0
Iron	S	1.41E+01	0	DNA	5	No CPF	0
Manganese	S	5.64E-01	0	DNA	1	No CPF	0
Nickel	S	2.25E-01	0	DNA	5	No CPF	0
Phosphorus	S	2.60E+01	0	DNA	2	No CPF	0
Strontium	S	2.53E-01	0	DNA	5	No CPF	0
Uranium	S	3.43E+02	0	DNA	0.6	No CPF	0
Vanadium	S	1.84E-01	0	DNA	5	No CPF	0
Zinc	S	4.50E-01	0	DNA	5	No CPF	0
Xylenes	S	2.02E-05	<0.001	12032	0.02	No CPF	C/A
Acetate $C_2H_3O_2$.	S	1.41E-01	<0.001	10481	0	No CPF	No RfD
Bismuth	S	1.42E+00	5.8E-03	10481	0	No CPF	No RfD
Calcium	S	2.22E+00	0	DNA	2	No CPF	No RfD
Chloride	S	6.44E-02	<0.001	10481	0	No CPF	No RfD
Europium	S	1.00E-01	0	DNA	5	No CPF	No RfD
Formate+A2	S	8.03E-02	<0.001	10481	0	No CPF	No RfD
Lead	S	3.38E+00	0	DNA	5	No CPF	No RfD
Mercury	S	2.45E-03	0	DNA	5	No CPF	No RfD
Praseodymium	S	1.78E+00	7.3E-03	10481	0	No CPF	No RfD

Table B-2. Maximum Value for Incremental Lifetime Cancer Risk and Hazard Index per Nonradionuclide Contaminant of Potential Concern using Average Post-Retrieval Inventory. (5 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fenceline Concentration (µg/L)	Peak Year	K_d (mL/g)[b]	Incremental Lifetime Cancer Risk (Groundwater)[c]	Hazard Quotient (Groundwater)[c]
						WAC-173-340 Method B	WAC-173-340 Method B
Silicon	S	2.21E+00	0	DNA	5	No CPF	No RfD
Sodium	S	6.15E+01	2.5E-01	10481	0	No CPF	No RfD
Thorium	S	1.93E-02	0	DNA	1	No CPF	No RfD
Titanium	S	4.87E-02	0	DNA	5	No CPF	No RfD
Zirconium	S	1.15E-01	0	DNA	5	No CPF	No RfD
Nitrite	U	5.47E-01	2.2E-03	10481	0	No CPF	1.4E-06
Aluminum	U	2.01E-01	0	DNA	1	No CPF	0
Antimony	U	1.01E-01	0	DNA	1	No CPF	0
Arsenic	U	1.01E-01	0	DNA	5	0	0
Beryllium	U	1.61E-02	0	DNA	5	No CPF	0
Boron	U	3.02E-02	0	DNA	2	No CPF	0
Cadmium	U	1.06E-02	0	DNA	1	No CPF	0
Cyanide	U	2.29E-03	0	DNA	5	No CPF	0
Lithium	U	1.61E-02	0	DNA	5	No CPF	0
Molybdenum	U	2.01E-02	0	DNA	2	No CPF	0
Selenium	U	1.01E-01	0	DNA	5	No CPF	0
Silver	U	1.21E-02	0	DNA	2	No CPF	0
Thallium	U	2.01E-01	0	DNA	5	No CPF	0
Tin	U	8.04E-02	0	DNA	5	No CPF	0
Acenaphthene	U	4.31E-04	0	DNA	1	No CPF	0
Butylbenzylphthalate	U	8.26E-04	0	DNA	2	No CPF	0
Di-n-butylphthalate	U	2.81E-03	0	DNA	1	No CPF	0
Di-n-octylphthalate	U	4.97E-04	0	DNA	5	No CPF	0
Fluoranthene	U	4.43E-04	0	DNA	5	No CPF	0
Hexachlorobutadiene	U	4.48E-04	0	DNA	5	0	0
Hexachloroethane	U	2.29E-06	0	DNA	5	0	0
Naphthalene	U	4.28E-04	0	DNA	0.6	No CPF	0
Pyrene	U	4.28E-04	0	DNA	5	No CPF	0

Table B-2. Maximum Value for Incremental Lifetime Cancer Risk and Hazard Index per Nonradionuclide Contaminant of Potential Concern using Average Post-Retrieval Inventory. (5 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fenceline Concentration (µg/L)	Peak Year	K_d (mL/g)[b]	Incremental Lifetime Cancer Risk (Groundwater)[c]	Hazard Quotient (Groundwater)[c]
						WAC-173-340 Method B	WAC-173-340 Method B
Aroclor-1254	U	6.31E-05	0	DNA	5	0	0
N-nitroso-di-n-propylamine	U	3.99E-04	<0.001	10481	0	C/A	No RfD
1, 1, 1-Trichloroethane	U	3.47E-06	<0.001	12032	0.02	No CPF	C/A
1, 1, 2, 2-Tetrachloroethane	U	2.54E-06	<0.001	12032	0.02	C/A	C/A
1, 1, 2-Trichloro-1, 2, 2-trifluoroethane	U	3.94E-06	<0.001	12032	0.2	No CPF	C/A
1, 1, 2-Trichloroethane	U	2.54E-06	<0.001	12032	0.02	C/A	C/A
1, 1, 2-Trichloroethylene	U	4.90E-06	<0.001	12032	0.02	C/A	C/A
1, 1-Dichloroethene	U	4.01E-06	<0.001	10481	0	No CPF	C/A
1, 2, 4-Trichlorobenzene	U	3.98E-06	<0.001	12032	0.2	No CPF	C/A
1, 2-Dichloroethane	U	2.49E-06	<0.001	10481	0	C/A	C/A
1, 4-Dichlorobenzene	U	4.16E-04	<0.001	12032	0.1	C/A	C/A
2, 4, 5-Trichlorophenol	U	3.89E-04	<0.001	12032	0.2	No CPF	C/A
2, 4, 6-Trichlorophenol	U	4.03E-04	<0.001	12032	0.1	C/A	C/A
2, 4-Dinitrotoluene	U	4.46E-04	<0.001	12032	0.1	No CPF	C/A
2-Chlorophenol	U	4.08E-04	<0.001	10481	0	No CPF	C/A
2-Ethoxyethanol	U	9.10E-04	<0.001	10481	0	No CPF	C/A
2-Methylphenol (o-cresol)	U	4.25E-04	<0.001	12032	0.1	No CPF	C/A
4-Methyl-2-pentanone (MIBK)	U	5.10E-06	<0.001	12032	0.02	No CPF	C/A
Benzene	U	2.44E-06	<0.001	10481	0	C/A	C/A
Carbon disulfide	U	3.59E-06	<0.001	10481	0	No CPF	C/A
Carbon tetrachloride	U	4.57E-06	<0.001	10481	0	C/A	C/A
Chlorobenzene	U	3.00E-06	<0.001	12032	0.02	No CPF	C/A
Chloroethene(vinyl chloride)	U	1.72E-06	<0.001	10481	0	C/A	C/A
Chloroform	U	3.67E-06	<0.001	10481	0	C/A	C/A
Cyclohexanone	U	2.78E-03	<0.001	10481	0	No CPF	C/A
Dichloromethane (methylene chloride)	U	2.98E-06	<0.001	10481	0	C/A	C/A
Diethyl ether	U	3.44E-06	<0.001	10481	0	No CPF	C/A
Ethyl acetate	U	3.79E-06	<0.001	10481	0	No CPF	C/A

Table B-2. Maximum Value for Incremental Lifetime Cancer Risk and Hazard Index per Nonradionuclide Contaminant of Potential Concern using Average Post-Retrieval Inventory. (5 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fenceline Concentration (µg/L)	Peak Year	K_d (mL/g)[b]	Incremental Lifetime Cancer Risk (Groundwater)[c]	Hazard Quotient (Groundwater)[c]
						WAC-173-340 Method B	WAC-173-340 Method B
Ethylbenzene	U	5.90E-06	<0.001	12032	0.02	No CPF	C/A
Isobutanol	U	2.31E-03	<0.001	10481	0	No CPF	C/A
n-Butyl alcohol (1-butanol)	U	1.72E-03	<0.001	10481	0	No CPF	C/A
Nitrobenzene	U	4.46E-04	<0.001	10481	0	No CPF	C/A
o-Dichlorobenzene	U	6.74E-04	<0.001	12032	0.1	No CPF	C/A
Pentachlorophenol	U	3.34E-04	<0.001	12032	0.1	C/A	C/A
Phenol	U	4.11E-04	<0.001	10481	0	No CPF	C/A
Pyridine	U	3.94E-04	<0.001	10481	0	No CPF	C/A
Tetrachloroethylene	U	3.18E-06	<0.001	12032	0.02	C/A	C/A
Toluene	U	2.96E-06	<0.001	12032	0.02	No CPF	C/A
Trichlorofluoromethane	U	3.62E-06	<0.001	12032	0.02	No CPF	C/A
Ammonium NH_4	U	4.96E-02	<0.001	10481	0	No CPF	No RfD
Bromide	U	2.80E-02	<0.001	10481	0	No CPF	No RfD
Cerium	U	1.41E-01	<0.001	10481	0	No CPF	No RfD
Glycolate	U	1.85E+00	7.6E-03	10481	0	No CPF	No RfD
Lanthanum	U	1.21E-02	<0.001	10481	0	No CPF	No RfD
Magnesium	U	8.04E-02	0	DNA	2	No CPF	No RfD
Neodymium	U	8.04E-02	<0.001	10481	0	No CPF	No RfD
Niobium	U	1.01E-01	0	DNA	5	No CPF	No RfD
Oxalate	U	5.47E-01	2.2E-03	10481	0	No CPF	No RfD
Palladium	U	2.01E-01	0	DNA	5	No CPF	No RfD
Potassium	U	1.01E+00	4.1E-03	10481	0	No CPF	No RfD
Rhodium	U	4.02E-01	1.7E-03	10481	0	No CPF	No RfD
Rubidium	U	6.03E+00	2.5E-02	10481	0	No CPF	No RfD
Ruthenium	U	1.21E-01	0	DNA	1	No CPF	No RfD
Samarium	U	4.02E-02	0	DNA	1	No CPF	No RfD
Sulfide	U	5.95E-03	<0.001	10481	0	No CPF	No RfD
Sulfur	U	1.21E-01	<0.001	10481	0	No CPF	No RfD

Table B-2. Maximum Value for Incremental Lifetime Cancer Risk and Hazard Index per Nonradionuclide Contaminant of Potential Concern using Average Post-Retrieval Inventory. (5 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fenceline Concentration (µg/L)	Peak Year	K_d (mL/g)[b]	Incremental Lifetime Cancer Risk (Groundwater)[c]	Hazard Quotient (Groundwater)[c]
						WAC-173-340 Method B	WAC-173-340 Method B
Tantalum	U	8.04E-02	<0.001	10481	0	No CPF	No RfD
Tellurium	U	1.61E-01	<0.001	10481	0	No CPF	No RfD
Tungsten	U	1.21E-01	<0.001	10481	0	No CPF	No RfD
Yttrium	U	1.01E-02	<0.001	10481	0	No CPF	No RfD
2-Nitropropane	U	6.07E-06	<0.001	10481	0	No CPF	No RfD
Cresylic acid (cresol, mixed isomers)	U	1.85E-03	<0.001	12032	0.1	No CPF	No RfD
o-Nitrophenol	U	3.74E-04	<0.001	12032	0.02	No CPF	No RfD
p-Chloro-m-cresol (4-Chloro-3-methylphenol)	U	4.18E-04	<0.001	12032	0.2	No CPF	No RfD
Performance Objective[d]						**1.0E-06[e]**	**1.0[f]**

[a] U indicates analyte was not detected in sludge. S indicates analyte was detected in the sludge.

[b] See PNNL-13895, *Hanford Contaminant Distribution Coefficient Database and Users Guide*, Rev. 1, for the basis for the K_d values listed for chromium and nitrate. The K_d values listed for the organic chemical compounds are determined from the chemicals' organic carbon/water partitioning coefficient and an estimate of 0.03% for the Hanford Site sediments fraction of organic content (PNNL-13895, Rev. 1, page 11, paragraph 3).

[c] All exposure scenarios are described in HNF-SD-WM-TI-707.

[d] Single Analyte Performance objectives apply to entire WMA, not just a single component of the WMA.

[e] *Washington Administrative Code* (WAC) 173-340-705 (2)(c)(ii), "Dangerous Waste Regulations."

[f] WAC 173-340-705 (2)(c)(i).

C/A = constituent analyzed, but this risk metric was not calculated because the nonradioactive analyte was predicted to have a concentration less than 0.001 µg/L, which is well below the ability of standard laboratory analytical methods to detect it..

DNA = did not arrive at fenceline at a concentration greater than 0.001 µg/L within the 10,000 year modeling period.

NDF = no dose factor.

No CPF = no cancer potency factor available.

No RfD = no reference dose available.

Table B-3. Incremental Lifetime Cancer Risk, Radiological Dose, and Drinking Water Dose per Radionuclide Contaminant of Potential Concern for the UCL 95% Inventory. (2 sheets)

Analyte Name	Detect[a]	Inventory (Ci)	WMA C Fenceline Concentration (pCi/L)	Peak Year	K_d (mL/g)[b]	Half-Life (yr)	Incremental Cancer Risk Scenarios (Groundwater)		Radiological Dose Groundwater (mrem/yr)	Radiological Dose Beta/Photon (mrem/yr)
							Industrial[c]	Residential[c]	All-Pathway Farmer[c]	Drinking Water MCL[c]
^{99}Tc	S	4.32E-03	1.73E-02	10461	0	211,097	2.38E-10	5.79E-09	3.02E-05	7.67E-05
^{129}I	S	4.21E-05	>0.001	12032	0.2	15,700,000	C/A	C/A	C/A	C/A
^{63}Ni	S	8.15E-02	0		5	100.1	0	0	0	0
^{90}Sr +D	S	3.01E+02	0		5	28.149	0	0	0	0
^{137}Cs + D	S	1.57E+01	0		5	29.999	0	0	0	0
^{228}Th + D	S	1.35E-05	0		2	1.9129	0	0	0	N/A
^{232}Th	S	4.39E-06	0		2	1.405E+10	0	0	0	N/A
^{234}U	S	1.46E-01	0		0.6	245,694	0	0	0	N/A
^{235}U + D	S	5.79E-03	0		0.6	703,700,000	0	0	0	N/A
^{236}U	S	1.10E-03	0		0.6	23,420,000	0	0	0	N/A
^{238}U + D	S	1.31E-01	0		0.6	4.468E+09	0	0	0	N/A
^{239}Pu	S	8.40E-01	0		2	24,110	0	0	0	N/A
^{240}Pu	S	1.81E-01	0		2	6,563	0	0	0	N/A
^{241}Pu + D	S	1.04E+00	0		2	14.35	0	0	0	0
^{241}Am	S	4.79E-02	0		2	432.7	0	0	0	N/A
^{3}H	U	1.00E-03	0		0	12.33	0	0	0	0
^{14}C	U	1.13E-03	1.74E-03	9781	0	5,730	1.35E-11	9.74E-11	8.41E-06	3.47E-06
^{60}Co	U	2.43E-02	0		0.1	5.2713	0	0	0	0
^{79}Se	U	1.28E-03	0		2	805,000	0	0	0	N/A
^{125}Sb	U	2.42E-01	0		1	2.7299	0	0	0	0
^{152}Eu	U	1.16E-01	0		1	13.33	0	0	0	0
^{154}Eu	U	8.02E-02	0		1	8.5919	0	0	0	0
^{155}Eu	U	2.49E-01	0		1	4.68	0	0	0	0
^{230}Th	U	8.72E-03	0		2	75,380	0	0	0	N/A
^{233}U	U	1.05E-01	0		0.6	159,198	0	0	0	N/A

Table B-3. Incremental Lifetime Cancer Risk, Radiological Dose, and Drinking Water Dose per Radionuclide Contaminant of Potential Concern for the UCL 95% Inventory. (2 sheets)

Analyte Name	Detect[a]	Inventory (Ci)	WMA C Fenceline Concentration (pCi/L)	Peak Year	K_d (mL/g)[b]	Half-Life (yr)	Incremental Cancer Risk Scenarios (Groundwater)		Radiological Dose Groundwater (mrem/yr)	Radiological Dose Beta/Photon (mrem/yr)
							Industrial[c]	Residential[c]	All-Pathway Farmer[c]	Drinking Water MCL[c]
^{237}Np	U	2.30E-02	0		2	2,140,000	0	0	0	N/A
^{238}Pu	U	3.43E-02	0		2	87.697	0	0	0	N/A
^{242}Cm	U	9.10E-03	0		2	0.44611	0	0	0	N/A
^{243}Cm	U	3.64E-04	0		2	28.499	0	0	0	N/A
^{244}Cm	U	8.74E-03	0		2	18.1	0	0	0	N/A
Performance Objectives[d]							1-0E-6 to 1.0E-4[e]	1-0E-6 to 1.0E-4[e]	25[f]	4[g]

[a] U indicates analyte was not detected in sludge. S indicates analyte was detected in the sludge.

[b] See PNNL-13895, *Hanford Contaminant Distribution Coefficient Database and Users Guide*, Rev. 1, and Section 4.3 of PNNL-14702, *Vadose Zone Hydrogeology Data Package* for the basis for the K_d values listed for the radionuclides.

[c] All exposure scenarios are described in HNF-SD-WM-TI-707.

[d] Performance objectives apply to the cumulative (i.e., all contaminants) for the entire WMA

[e] EPA/540/R-99/006, *Radiation Risk Assessment at CERCLA Sites: Q & A, Directive* 9200.4-31P.

[f] DOE O 435.1, *Radioactive Waste Management.*

[g] 65 FR 76708, "National Primary Drinking Water Regulations; Radionuclides; Final Rule."

C/A = constituent analyzed, but this risk metric was not calculated because the radioactive analyte was predicted to have a concentration less than 0.001 pCi/L, which is well below the ability of standard laboratory analytical methods to detect it.

DNA = did not arrive at fenceline at a concentration greater than 0.001 pCi/L within the 10,000 year modeling period.

N/A = radionuclide is not a beta/photon emitter.

NDF = no dose factor.

Table B-4. Maximum Value for Incremental Lifetime Cancer Risk and Hazard Index per Nonradionuclide Contaminant of Potential Concern using UL 95% Post-Retrieval Inventory. (5 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fenceline Concentration (µg/L)	Peak Year	K_d (mL/g)[b]	Incremental Lifetime Cancer Risk (Groundwater)[c] WAC-173-340 Method B	Hazard Quotient (Groundwater)[c] WAC-173-340 Method B
Chromium	S	4.03E+00	1.7E-02	10481	0	No CPF	4.3E-04
Fluoride	S	2.41E+00	9.9E-03	10481	0	No CPF	1.0E-05
Nitrate	S	5.06E+00	2.1E-02	10481	0	No CPF	8.1E-07
Cobalt	S	3.00E-02	<0.001	12032	0.1	No CPF	C/A
2-Butanone(MEK)	S	1.23E-04	<0.001	10481	0	No CPF	C/A
2-Propanone (Acetone)	S	3.17E-04	<0.001	10481	0	No CPF	C/A
o-Xylene	S	1.55E-05	<0.001	12032	0.02	No CPF	C/A
Tributyl phosphate	S	1.05E+01	<0.001	12032	0.2	C/A	C/A
Barium	S	5.76E-02	0	DNA	5	No CPF	0
Copper	S	7.39E-02	0	DNA	5	No CPF	0
Iron	S	1.93E+01	0	DNA	5	No CPF	0
Manganese	S	7.27E-01	0	DNA	1	No CPF	0
Nickel	S	3.10E-01	0	DNA	5	No CPF	0
Phosphorus	S	2.85E+01	0	DNA	2	No CPF	0
Strontium	S	3.09E-01	0	DNA	5	No CPF	0
Uranium	S	3.78E+02	0	DNA	0.6	No CPF	0
Vanadium	S	2.08E-01	0	DNA	5	No CPF	0
Zinc	S	7.55E-01	0	DNA	5	No CPF	0
Xylenes	S	4.69E-05	<0.001	12032	0.02	No CPF	C/A
Acetate $C_2H_3O_2$.	S	1.91E-01	<0.001	10481	0	No CPF	No RfD
Bismuth	S	1.56E+00	6.4E-03	10481	0	No CPF	No RfD
Calcium	S	2.52E+00	0	DNA	2	No CPF	No RfD
Chloride	S	7.98E-02	<0.001	10481	0	No CPF	No RfD
Europium	S	1.10E-01	0	DNA	5	No CPF	No RfD
Formate+A2	S	9.90E-02	<0.001	10481	0	No CPF	No RfD
Lead	S	4.11E+00	0	DNA	5	No CPF	No RfD
Mercury	S	3.30E-03	0	DNA	5	No CPF	No RfD

Table B-4. Maximum Value for Incremental Lifetime Cancer Risk and Hazard Index per Nonradionuclide Contaminant of Potential Concern using UL 95% Post-Retrieval Inventory. (5 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fenceline Concentration (µg/L)	Peak Year	K_d (mL/g)[b]	Incremental Lifetime Cancer Risk (Groundwater)[c]	Hazard Quotient (Groundwater)[c]
						WAC-173-340 Method B	WAC-173-340 Method B
Praseodymium	S	1.96E+00	8.1E-03	10481	0	No CPF	No RfD
Silicon	S	3.23E+00	0	DNA	5	No CPF	No RfD
Sodium	S	6.79E+01	2.8E-01	10481	0	No CPF	No RfD
Thorium	S	4.07E-02	0	DNA	1	No CPF	No RfD
Titanium	S	6.24E-02	0	DNA	5	No CPF	No RfD
Zirconium	S	1.28E-01	0	DNA	5	No CPF	No RfD
Nitrite	U	1.64E+00	6.7E-03	10481	0	No CPF	4.21E-06
Aluminum	U	6.04E-01	0	DNA	1	No CPF	0
Antimony	U	3.02E-01	0	DNA	1	No CPF	0
Arsenic	U	3.02E-01	0	DNA	5	0	0
Beryllium	U	4.83E-02	0	DNA	5	No CPF	0
Boron	U	9.07E-02	0	DNA	2	No CPF	0
Cadmium	U	3.18E-02	0	DNA	1	No CPF	0
Cyanide	U	6.80E-03	0	DNA	5	No CPF	0
Lithium	U	4.83E-02	0	DNA	5	No CPF	0
Molybdenum	U	6.04E-02	0	DNA	2	No CPF	0
Selenium	U	3.02E-01	0	DNA	5	No CPF	0
Silver	U	3.63E-02	0	DNA	2	No CPF	0
Thallium	U	6.04E-01	0	DNA	5	No CPF	0
Tin	U	2.42E-01	0	DNA	5	No CPF	0
Acenaphthene	U	1.29E-03	0	DNA	1	No CPF	0
Butylbenzylphthalate	U	2.48E-03	0	DNA	2	No CPF	0
Di-n-butylphthalate	U	8.45E-03	0	DNA	1	No CPF	0
Di-n-octylphthalate	U	1.49E-03	0	DNA	5	No CPF	0
Fluoranthene	U	1.33E-03	0	DNA	5	No CPF	0
Hexachlorobutadiene	U	1.35E-03	0	DNA	5	0	0
Hexachloroethane	U	6.88E-06	0	DNA	5	0	0
Naphthalene	U	1.28E-03	0	DNA	0.6	No CPF	0

Table B-4. Maximum Value for Incremental Lifetime Cancer Risk and Hazard Index per Nonradionuclide Contaminant of Potential Concern using UL 95% Post-Retrieval Inventory. (5 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fenceline Concentration (µg/L)	Peak Year	K_d (mL/g)[b]	Incremental Lifetime Cancer Risk (Groundwater)[c]	Hazard Quotient (Groundwater)[c]
						WAC-173-340 Method B	WAC-173-340 Method B
Pyrene	U	1.28E-03	0	DNA	5	No CPF	0
Aroclor-1254	U	1.89E-04	0	DNA	5	0	0
N-nitroso-di-n-propylamine	U	1.20E-03	<0.001	10481	0	C/A	No RfD
1, 1, 1-Trichloroethane	U	1.04E-05	<0.001	12032	0.02	No CPF	C/A
1, 1, 2, 2-Tetrachloroethane	U	7.64E-06	<0.001	12032	0.02	C/A	C/A
1, 1, 2-Trichloro-1, 2, 2-trifluoroethane	U	1.18E-05	<0.001	12032	0.2	No CPF	C/A
1, 1, 2-Trichloroethane	U	7.64E-06	<0.001	12032	0.02	C/A	C/A
1, 1, 2-Trichloroethylene	U	1.47E-05	<0.001	12032	0.02	C/A	C/A
1, 1-Dichloroethene	U	1.20E-05	<0.001	10481	0	No CPF	C/A
1, 2, 4-Trichlorobenzene	U	1.19E-05	<0.001	12032	0.2	No CPF	C/A
1, 2-Dichloroethane	U	7.49E-06	<0.001	10481	0	C/A	C/A
1, 4-Dichlorobenzene	U	1.25E-03	<0.001	12032	0.1	C/A	C/A
2, 4, 5-Trichlorophenol	U	1.17E-03	<0.001	12032	0.2	No CPF	C/A
2, 4, 6-Trichlorophenol	U	1.21E-03	<0.001	12032	0.1	C/A	C/A
2, 4-Dinitrotoluene	U	1.34E-03	<0.001	12032	0.1	No CPF	C/A
2-Chlorophenol	U	1.22E-03	<0.001	10481	0	No CPF	C/A
2-Ethoxyethanol	U	2.73E-03	<0.001	10481	0	No CPF	C/A
2-Methylphenol (o-cresol)	U	1.27E-03	<0.001	12032	0.1	No CPF	C/A
4-Methyl-2-pentanone (MIBK)	U	1.53E-05	<0.001	12032	0.02	No CPF	C/A
Benzene	U	7.33E-06	<0.001	10481	0	C/A	C/A
Carbon disulfide	U	1.08E-05	<0.001	10481	0	No CPF	C/A
Carbon tetrachloride	U	1.37E-05	<0.001	10481	0	C/A	C/A
Chlorobenzene	U	9.00E-06	<0.001	12032	0.02	No CPF	C/A
Chloroethene(vinyl chloride)	U	5.16E-06	<0.001	10481	0	C/A	C/A
Chloroform	U	1.10E-05	<0.001	10481	0	C/A	C/A
Cyclohexanone	U	8.35E-03	<0.001	10481	0	No CPF	C/A
Dichloromethane (methylene chloride)	U	8.95E-06	<0.001	10481	0	C/A	C/A
Diethyl ether	U	1.03E-05	<0.001	10481	0	No CPF	C/A

Table B-4. Maximum Value for Incremental Lifetime Cancer Risk and Hazard Index per Nonradionuclide Contaminant of Potential Concern using UL 95% Post-Retrieval Inventory. (5 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fenceline Concentration (µg/L)	Peak Year	K_d (mL/g)[b]	Incremental Lifetime Cancer Risk (Groundwater)[c]	Hazard Quotient (Groundwater)[c]
						WAC-173-340 Method B	WAC-173-340 Method B
Ethyl Acetate	U	1.14E-05	<0.001	10481	0	No CPF	C/A
Ethylbenzene	U	1.77E-05	<0.001	12032	0.02	No CPF	C/A
Isobutanol	U	6.93E-03	<0.001	10481	0	No CPF	C/A
n-Butyl alcohol (1-butanol)	U	5.16E-03	<0.001	10481	0	No CPF	C/A
Nitrobenzene	U	1.34E-03	<0.001	10481	0	No CPF	C/A
o-Dichlorobenzene	U	2.02E-03	<0.001	12032	0.1	No CPF	C/A
Pentachlorophenol	U	1.00E-03	<0.001	12032	0.1	C/A	C/A
Phenol	U	1.23E-03	<0.001	10481	0	No CPF	C/A
Pyridine	U	1.18E-03	<0.001	10481	0	No CPF	C/A
Tetrachloroethylene	U	9.56E-06	<0.001	12032	0.02	C/A	C/A
Toluene	U	9.16E-06	<0.001	12032	0.02	No CPF	C/A
Trichlorofluoromethane	U	1.09E-05	<0.001	12032	0.02	No CPF	C/A
Ammonium NH4	U	1.47E-01	<0.001	10481	0	No CPF	No RfD
Bromide	U	8.39E-02	<0.001	10481	0	No CPF	No RfD
Cerium	U	4.23E-01	1.7E-03	10481	0	No CPF	No RfD
Glycolate	U	5.55E+00	2.3E-02	10481	0	No CPF	No RfD
Lanthanum	U	3.63E-02	<0.001	10481	0	No CPF	No RfD
Magnesium	U	2.42E-01	0	DNA	2	No CPF	No RfD
Neodymium	U	2.42E-01	<0.001	10481	0	No CPF	No RfD
Niobium	U	3.02E-01	0	DNA	5	No CPF	No RfD
Oxalate	U	1.64E+00	6.7E-03	10481	0	No CPF	No RfD
Palladium	U	6.04E-01	0	DNA	5	No CPF	No RfD
Potassium	U	3.02E+00	1.2E-02	10481	0	No CPF	No RfD
Rhodium	U	1.21E+00	5.0E-03	10481	0	No CPF	No RfD
Rubidium	U	1.81E+01	7.4E-02	10481	0	No CPF	No RfD
Ruthenium	U	3.63E-01	0	DNA	1	No CPF	No RfD
Samarium	U	1.21E-01	0	DNA	1	No CPF	No RfD
Sulfide	U	1.82E-02	<0.001	10481	0	No CPF	No RfD

Table B-4. Maximum Value for Incremental Lifetime Cancer Risk and Hazard Index per Nonradionuclide Contaminant of Potential Concern using UL 95% Post-Retrieval Inventory. (5 sheets)

Analyte	Detect[a]	Inventory (kg)	WMA C Fenceline Concentration (µg/L)	Peak Year	K_d (mL/g)[b]	Incremental Lifetime Cancer Risk (Groundwater)[c]	Hazard Quotient (Groundwater)[c]
						WAC-173-340 Method B	WAC-173-340 Method B
Sulfur	U	3.63E-01	1.5E-03	10481	0	No CPF	No RfD
Tantalum	U	2.42E-01	<0.001	10481	0	No CPF	No RfD
Tellurium	U	4.83E-01	2.0E-03	10481	0	No CPF	No RfD
Tungsten	U	3.63E-01	1.5E-03	10481	0	No CPF	No RfD
Yttrium	U	3.02E-02	<0.001	10481	0	No CPF	No RfD
2-Nitropropane	U	1.82E-05	<0.001	10481	0	No CPF	No RfD
Cresylic acid (cresol, mixed isomers)	U	5.56E-03	<0.001	12032	0.1	No CPF	No RfD
o-Nitrophenol	U	1.12E-03	<0.001	12032	0.02	No CPF	No RfD
p-Chloro-m-cresol (4-Chloro-3-methylphenol)	U	1.25E-03	<0.001	12032	0.2	No CPF	No RfD
Performance Objective[d]						**1.0E-06[e]**	**1.0[f]**

[a] U indicates analyte was not detected in liquid or sludge. S indicates analyte was detected in the sludge.
[b] See PNNL-13895, *Hanford Contaminant Distribution Coefficient Database and Users Guide*, Rev. 1, for the basis for the K_d values listed for chromium and nitrate. The K_d values listed for the organic chemical compounds are determined from the chemicals' organic carbon/water partitioning coefficient and an estimate of 0.03% for the Hanford Site sediments fraction of organic content (PNNL-13895, Rev. 1, page 11, paragraph 3).
[c] All exposure scenarios are described in HNF-SD-WM-TI-707.
[d] Single Analyte Performance objectives apply to entire WMA, not just a single component of the WMA.
[e] *Washington Administrative Code* (WAC) 173-340-705 (2)(c)(ii), "Dangerous Waste Regulations."
[f] WAC 173-340-705 (2)(c)(i).

C/A = constituent analyzed, but this risk metric was not calculated because the nonradioactive analyte was predicted to have a concentration less than 0.001 µg/L, which is well below the ability of standard laboratory analytical methods to detect it..
DNA = did not arrive at fenceline at a concentration greater than 0.001 µg/L within the 10,000 year modeling period.
NDF = no dose factor.
No CPF = no cancer potency factor available.
No RfD = no reference dose available.

Table B-5. Well Driller Scenario Doses (mrem) for Single-Shell Tank 241-C-203 (average) Showing Major Constituents (decayed as of March 15, 2005) and Pathways.

Nuclide	Years after Site Closure (1/1/2032)									
	100	200	300	400	500	600	700	800	900	1,000
^{14}C	2.3E-07	2.3E-07	2.2E-07	2.2E-07	2.2E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.0E-07
^{63}Ni	2.0E-06	9.9E-07	5.0E-07	2.5E-07	1.2E-07	6.2E-08	3.1E-08	1.6E-08	7.8E-09	3.9E-09
^{60}Co	8.3E-09	1.6E-14	3.1E-20	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
^{79}Se	9.0E-07	9.0E-07	9.0E-07	9.0E-07	9.0E-07	9.0E-07	9.0E-07	9.0E-07	9.0E-07	9.0E-07
^{90}Sr	3.8E-01	3.3E-02	2.8E-03	2.4E-04	2.0E-05	1.7E-06	1.5E-07	1.3E-08	1.1E-09	9.1E-11
^{99}Tc	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07
^{129}I	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07	7.6E-07
^{137}Cs	1.6E+00	1.5E-01	1.5E-02	1.5E-03	1.5E-04	1.5E-05	1.5E-06	1.5E-07	1.5E-08	1.5E-09
^{152}Eu	4.2E-04	2.3E-06	1.3E-08	7.1E-11	3.9E-13	2.9E-15	7.8E-16	7.7E-16	7.7E-16	7.7E-16
^{154}Eu	8.6E-06	2.7E-09	8.5E-13	2.7E-16	8.3E-20	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
^{230}Th	4.3E-03	6.1E-03	7.7E-03	9.3E-03	1.1E-02	1.2E-02	1.4E-02	1.5E-02	1.6E-02	1.7E-02
^{232}Th	2.4E-05	2.4E-05	2.4E-05	2.4E-05	2.4E-05	2.4E-05	2.4E-05	2.4E-05	2.4E-05	2.4E-05
^{233}U	6.0E-03	8.3E-03	1.1E-02	1.3E-02	1.5E-02	1.7E-02	2.0E-02	2.2E-02	2.4E-02	2.6E-02
^{234}U	5.4E-03	5.5E-03	5.6E-03	5.8E-03	6.0E-03	6.2E-03	6.5E-03	6.7E-03	7.0E-03	7.4E-03
^{235}U	3.3E-03	3.4E-03	3.5E-03	3.6E-03	3.6E-03	3.7E-03	3.8E-03	3.9E-03	4.0E-03	4.1E-03
^{236}U	3.7E-05	3.7E-05	3.7E-05	3.7E-05	3.7E-05	3.7E-05	3.7E-05	3.7E-05	3.7E-05	3.7E-05
^{238}U	1.5E-02	1.5E-02	1.5E-02	1.5E-02	1.5E-02	1.5E-02	1.5E-02	1.5E-02	1.5E-02	1.5E-02
^{237}Np	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02	2.9E-02
^{238}Pu	6.5E-03	3.0E-03	1.3E-03	6.1E-04	2.8E-04	1.3E-04	5.7E-05	2.6E-05	1.2E-05	5.7E-06
^{239}Pu	4.9E-01	4.8E-01	4.8E-01	4.8E-01	4.8E-01	4.8E-01	4.8E-01	4.8E-01	4.7E-01	4.7E-01
^{240}Pu	1.0E-01	1.0E-01	1.0E-01	1.0E-01	1.0E-01	9.9E-02	9.7E-02	9.6E-02	9.5E-02	9.4E-02
^{241}Pu	1.8E-02	1.5E-02	1.3E-02	1.1E-02	9.6E-03	8.2E-03	7.0E-03	5.9E-03	5.1E-03	4.3E-03
^{241}Am	2.7E-02	2.3E-02	1.9E-02	1.7E-02	1.4E-02	1.2E-02	1.0E-02	8.7E-03	7.4E-03	6.3E-03
^{242m}Am	6.0E-03	4.5E-03	3.1E-03	2.0E-03	1.3E-03	8.4E-04	5.3E-04	3.3E-04	2.0E-04	1.3E-04
^{242}Cm	9.3E-06	4.2E-06	1.9E-06	8.6E-07	3.9E-07	1.8E-07	8.1E-08	3.7E-08	1.7E-08	8.0E-09
^{243}Cm	1.2E-05	1.3E-06	3.5E-07	2.6E-07	2.6E-07	2.6E-07	2.5E-07	2.5E-07	2.5E-07	2.5E-07
^{244}Cm	3.7E-05	1.5E-05	1.4E-05	1.4E-05	1.4E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05	1.3E-05
Cumulative	**2.7E+00**	**8.9E-01**	**7.1E-01**	**6.9E-01**	**6.9E-01**	**6.8E-01**	**6.8E-01**	**6.8E-01**	**6.8E-01**	**6.8E-01**
Internal	8.9E-01	6.9E-01	6.7E-01	6.6E-01	6.6E-01	6.6E-01	6.5E-01	6.5E-01	6.5E-01	6.5E-01
External	1.8E+00	2.0E-01	4.3E-02	2.8E-02	2.7E-02	2.7E-02	2.7E-02	2.7E-02	2.7E-02	2.7E-02

Table B-6. Rural Pasture Doses (mrem/y) for Single-Shell Tank C-203 (average) Showing Major Constituents (decayed as of March 15, 2005) and Pathways.

Nuclide	Years after Site Closure (1/1/2032)									
	100	200	300	400	500	600	700	800	900	1,000
^{14}C	2.3E-05	2.2E-05	2.2E-05	2.2E-05	2.1E-05	2.1E-05	2.1E-05	2.1E-05	2.0E-05	0.0E+00
^{63}Ni	4.7E-05	2.4E-05	1.2E-05	5.9E-06	3.0E-06	1.5E-06	7.4E-07	3.7E-07	1.9E-07	9.3E-08
^{60}Co	8.5E-10	1.6E-15	3.2E-21	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
^{79}Se	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06
^{90}Sr	2.0E+01	1.7E+00	1.4E-01	1.2E-02	1.0E-03	8.9E-05	7.6E-06	6.5E-07	5.5E-08	4.7E-09
^{99}Tc	1.2E-04	1.2E-04	1.2E-04	1.2E-04	1.2E-04	1.2E-04	1.2E-04	1.2E-04	1.2E-04	1.2E-04
^{129}I	6.9E-06	6.9E-06	6.9E-06	6.9E-06	6.9E-06	6.9E-06	6.9E-06	6.9E-06	6.9E-06	6.9E-06
^{137}Cs	3.8E-01	3.7E-02	3.7E-03	3.7E-04	3.6E-05	3.6E-06	3.6E-07	3.5E-08	3.5E-09	3.5E-10
^{152}Eu	4.3E-05	2.4E-07	1.3E-09	7.2E-12	4.0E-14	4.1E-16	2.0E-16	1.9E-16	1.9E-16	1.9E-16
^{154}Eu	8.7E-07	2.7E-10	8.6E-14	2.7E-17	8.4E-21	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
^{230}Th	9.4E-04	1.3E-03	1.6E-03	1.9E-03	2.2E-03	2.5E-03	2.7E-03	3.0E-03	3.2E-03	3.4E-03
^{232}Th	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06	3.8E-06
^{233}U	2.2E-03	2.7E-03	3.1E-03	3.6E-03	4.0E-03	4.5E-03	4.9E-03	5.4E-03	5.8E-03	6.3E-03
^{234}U	2.8E-03	2.8E-03	2.8E-03	2.9E-03	2.9E-03	2.9E-03	3.0E-03	3.0E-03	3.1E-03	3.2E-03
^{235}U	4.0E-04	4.2E-04	4.4E-04	4.6E-04	4.8E-04	5.0E-04	5.2E-04	5.4E-04	5.6E-04	5.8E-04
^{236}U	1.9E-05	1.9E-05	1.9E-05	1.9E-05	1.9E-05	1.9E-05	1.9E-05	1.9E-05	1.9E-05	1.9E-05
^{238}U	3.5E-03	3.5E-03	3.5E-03	3.5E-03	3.5E-03	3.5E-03	3.5E-03	3.5E-03	3.5E-03	3.5E-03
^{237}Np	5.6E-03	5.6E-03	5.6E-03	5.6E-03	5.6E-03	5.6E-03	5.6E-03	5.6E-03	5.6E-03	5.6E-03
^{238}Pu	1.7E-03	7.5E-04	3.4E-04	1.5E-04	7.0E-05	3.2E-05	1.5E-05	6.7E-06	3.2E-06	1.5E-06
^{239}Pu	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01	1.2E-01
^{240}Pu	2.6E-02	2.6E-02	2.6E-02	2.6E-02	2.5E-02	2.5E-02	2.5E-02	2.5E-02	2.4E-02	2.4E-02
^{241}Pu	4.5E-03	3.8E-03	3.3E-03	2.8E-03	2.4E-03	2.0E-03	1.7E-03	1.5E-03	1.2E-03	1.1E-03
^{241}Am	6.6E-03	5.6E-03	4.8E-03	4.1E-03	3.5E-03	3.0E-03	2.5E-03	2.2E-03	1.8E-03	1.6E-03
^{242m}Am	1.5E-03	1.1E-03	7.7E-04	5.1E-04	3.3E-04	2.1E-04	1.3E-04	8.3E-05	5.1E-05	3.2E-05
^{242}Cm	2.4E-06	1.1E-06	4.8E-07	2.2E-07	1.0E-07	4.5E-08	2.1E-08	9.5E-09	4.5E-09	2.2E-09
^{243}Cm	2.3E-06	2.6E-07	8.3E-08	6.7E-08	6.5E-08	6.5E-08	6.5E-08	6.4E-08	6.4E-08	6.4E-08
^{244}Cm	9.6E-06	3.7E-06	3.5E-06	3.5E-06	3.5E-06	3.4E-06	3.4E-06	3.4E-06	3.3E-06	3.3E-06
Cumulative	**20.4**	**1.9E+00**	**3.2E-01**	**1.9E-01**	**1.7E-01**	**1.7E-01**	**1.7E-01**	**1.7E-01**	**1.7E-01**	**1.7E-01**
Internal	20.2	1.9E+00	3.2E-01	1.8E-01	1.7E-01	1.7E-01	1.7E-01	1.7E-01	1.7E-01	1.7E-01
External	1.8E-01	1.9E-02	4.2E-03	2.6E-03	2.5E-03	2.5E-03	2.5E-03	2.5E-03	2.5E-03	2.5E-03

Table B-7. Suburban Garden Doses (mrem/y) for Single-Shell Tank C-203 (average) Showing Major Constituents (decayed as of March 15, 2007) and Pathways.

Nuclide	Years after Site Closure (1/1/2032)									
	100	200	300	400	500	600	700	800	900	1,000
^{14}C	3.9E-04	3.9E-04	3.9E-04	3.8E-04	3.8E-04	3.7E-04	3.7E-04	3.6E-04	3.6E-04	3.5E-04
^{63}Ni	3.2E-04	1.6E-04	8.0E-05	4.0E-05	2.0E-05	1.0E-05	5.0E-06	2.5E-06	1.3E-06	6.3E-07
^{60}Co	8.5E-09	1.6E-14	3.2E-20	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
^{79}Se	6.2E-05	6.2E-05	6.2E-05	6.2E-05	6.2E-05	6.2E-05	6.2E-05	6.2E-05	6.2E-05	6.2E-05
^{90}Sr	2.8E+02	2.4E+01	2.0E+00	1.7E-01	1.5E-02	1.3E-03	1.1E-04	9.2E-06	7.8E-07	6.7E-08
^{99T}c	9.5E-03	9.5E-03	9.5E-03	9.5E-03	9.5E-03	9.5E-03	9.5E-03	9.5E-03	9.5E-03	9.5E-03
^{129}I	3.4E-05	3.4E-05	3.4E-05	3.4E-05	3.4E-05	3.4E-05	3.4E-05	3.4E-05	3.4E-05	3.4E-05
^{137}Cs	3.6E+00	3.6E-01	3.6E-02	3.5E-03	3.5E-04	3.5E-05	3.5E-06	3.4E-07	3.4E-08	3.4E-09
^{152}Eu	4.1E-04	2.3E-06	1.3E-08	6.9E-11	3.8E-13	4.9E-15	2.8E-15	2.8E-15	2.8E-15	2.8E-15
^{154}Eu	8.4E-06	2.6E-09	8.2E-13	2.6E-16	8.1E-20	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
^{230}Th	1.6E-02	2.4E-02	3.1E-02	3.8E-02	4.5E-02	5.1E-02	5.7E-02	6.3E-02	6.9E-02	7.4E-02
^{232}Th	4.4E-05	4.4E-05	4.4E-05	4.4E-05	4.4E-05	4.4E-05	4.4E-05	4.4E-05	4.4E-05	4.4E-05
^{233}U	8.4E-02	9.1E-02	9.7E-02	1.0E-01	1.1E-01	1.2E-01	1.2E-01	1.3E-01	1.4E-01	1.4E-01
^{234}U	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.4E-01	1.4E-01	1.4E-01	1.4E-01
^{235}U	8.3E-03	8.7E-03	9.1E-03	9.6E-03	1.0E-02	1.0E-02	1.1E-02	1.1E-02	1.2E-02	1.2E-02
^{236}U	9.2E-04	9.2E-04	9.2E-04	9.2E-04	9.2E-04	9.2E-04	9.2E-04	9.2E-04	9.2E-04	9.2E-04
^{238}U	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01	1.3E-01
^{237}Np	3.9E-01	3.9E-01	3.9E-01	3.9E-01	3.9E-01	3.9E-01	3.9E-01	3.9E-01	3.9E-01	3.9E-01
^{238}Pu	3.7E-02	1.7E-02	7.5E-03	3.4E-03	1.6E-03	7.1E-04	3.3E-04	1.5E-04	7.4E-05	3.8E-05
^{239}Pu	2.7E+00	2.7E+00	2.7E+00	2.7E+00	2.7E+00	2.7E+00	2.7E+00	2.7E+00	2.7E+00	2.7E+00
^{240}Pu	5.9E-01	5.8E-01	5.7E-01	5.7E-01	5.6E-01	5.6E-01	5.5E-01	5.5E-01	5.4E-01	5.3E-01
^{241}Pu	9.8E-02	8.4E-02	7.1E-02	6.1E-02	5.2E-02	4.4E-02	3.8E-02	3.2E-02	2.7E-02	2.3E-02
^{241}Am	1.4E-01	1.2E-01	1.0E-01	8.9E-02	7.6E-02	6.5E-02	5.5E-02	4.7E-02	4.0E-02	3.4E-02
^{242m}Am	3.3E-02	2.4E-02	1.7E-02	1.1E-02	7.3E-03	4.6E-03	2.9E-03	1.8E-03	1.1E-03	7.0E-04
^{242}Cm	5.2E-05	2.4E-05	1.1E-05	4.9E-06	2.2E-06	1.0E-06	4.6E-07	2.2E-07	1.0E-07	5.4E-08
^{243}Cm	4.4E-05	5.2E-06	1.8E-06	1.5E-06	1.4E-06	1.4E-06	1.4E-06	1.4E-06	1.4E-06	1.4E-06
^{244}Cm	2.1E-04	8.2E-05	7.9E-05	7.8E-05	7.7E-05	7.6E-05	7.5E-05	7.5E-05	7.4E-05	7.3E-05
Cumulative	**289.4**	**28.7**	**6.4**	**4.4**	**4.3**	**4.2**	**4.2**	**4.2**	**4.2**	**4.2**
Internal	287.7	28.5	6.3	4.4	4.2	4.2	4.2	4.2	4.1	4.1
External	1.7	1.9E-01	4.0E-02	2.5E-02	2.4E-02	2.4E-02	2.4E-02	2.4E-02	2.4E-02	2.4E-02

Table B-8. Commercial Farm Doses (mrem/y) for Single-Shell Tank 241-C-203 (average) Showing Major Constituents (decayed as of March 15, 2005) and Pathways.

Nuclide	Years after Site Closure (1/1/2032)									
	100	200	300	400	500	600	700	800	900	1,000
^{14}C	1.1E-09	1.1E-09	1.1E-09	1.1E-09	1.0E-09	1.0E-09	1.0E-09	1.0E-09	9.9E-10	9.8E-10
^{63}Ni	1.0E-08	5.1E-09	2.5E-09	1.3E-09	6.3E-10	3.2E-10	1.6E-10	7.9E-11	4.0E-11	2.0E-11
^{60}Co	3.2E-11	6.3E-17	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
^{79}Se	4.2E-09	4.2E-09	4.2E-09	4.2E-09	4.2E-09	4.2E-09	4.2E-09	4.2E-09	4.2E-09	4.2E-09
^{90}Sr	1.6E-03	1.4E-04	1.2E-05	1.0E-06	8.6E-08	7.4E-09	6.3E-10	5.3E-11	4.6E-12	3.9E-13
^{99}Tc	3.1E-09	3.1E-09	3.1E-09	3.1E-09	3.1E-09	3.1E-09	3.1E-09	3.1E-09	3.1E-09	3.1E-09
^{129}I	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09	3.2E-09
^{137}Cs	6.0E-03	6.0E-04	5.9E-05	5.9E-06	5.8E-07	5.8E-08	5.7E-09	5.7E-10	5.6E-11	5.6E-12
^{152}Eu	1.6E-06	9.0E-09	5.0E-11	2.7E-13	1.5E-15	1.5E-17	6.9E-18	6.8E-18	6.8E-18	6.8E-18
^{154}Eu	3.3E-08	1.0E-11	3.3E-15	1.0E-18	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
^{230}Th	2.7E-05	3.4E-05	4.1E-05	4.7E-05	5.3E-05	5.9E-05	6.5E-05	7.0E-05	7.6E-05	8.1E-05
^{232}Th	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07	1.1E-07
^{233}U	3.8E-05	5.4E-05	6.9E-05	8.5E-05	1.0E-04	1.2E-04	1.3E-04	1.5E-04	1.6E-04	1.7E-04
^{234}U	3.1E-05	3.1E-05	3.2E-05	3.3E-05	3.4E-05	3.5E-05	3.6E-05	3.8E-05	3.9E-05	4.0E-05
^{235}U	1.2E-05	1.3E-05	1.3E-05	1.4E-05	1.4E-05	1.5E-05	1.5E-05	1.6E-05	1.7E-05	1.7E-05
^{236}U	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07	2.1E-07
^{238}U	6.4E-05	6.4E-05	6.4E-05	6.4E-05	6.4E-05	6.4E-05	6.4E-05	6.4E-05	6.4E-05	6.4E-05
^{237}Np	1.7E-04	1.7E-04	1.7E-04	1.7E-04	1.7E-04	1.7E-04	1.7E-04	1.7E-04	1.7E-04	1.7E-04
^{238}Pu	4.7E-05	2.1E-05	9.6E-06	4.4E-06	2.0E-06	9.0E-07	4.1E-07	1.9E-07	8.6E-08	4.0E-08
^{239}Pu	3.5E-03	3.5E-03	3.5E-03	3.5E-03	3.4E-03	3.4E-03	3.4E-03	3.4E-03	3.4E-03	3.4E-03
^{240}Pu	7.5E-04	7.4E-04	7.3E-04	7.2E-04	7.1E-04	7.1E-04	7.0E-04	6.9E-04	6.9E-04	6.8E-04
^{241}Pu	1.3E-04	1.1E-04	9.2E-05	7.8E-05	6.7E-05	5.7E-05	4.9E-05	4.1E-05	3.5E-05	3.0E-05
^{241}Am	1.9E-04	1.6E-04	1.4E-04	1.2E-04	9.8E-05	8.4E-05	7.1E-05	6.1E-05	5.2E-05	4.4E-05
^{242m}Am	4.3E-05	3.1E-05	2.2E-05	1.4E-05	9.3E-06	5.9E-06	3.7E-06	2.3E-06	1.5E-06	9.0E-07
^{242}Cm	6.6E-08	3.0E-08	1.4E-08	6.2E-09	2.8E-09	1.3E-09	5.8E-10	2.6E-10	1.2E-10	5.7E-11
^{243}Cm	6.8E-08	7.7E-09	2.4E-09	1.9E-09	1.8E-09	1.8E-09	1.8E-09	1.8E-09	1.8E-09	1.8E-09
^{244}Cm	2.7E-07	1.0E-07	1.0E-07	9.9E-08	9.8E-08	9.7E-08	9.6E-08	9.5E-08	9.4E-08	9.3E-08
Cumulative	**1.3E-02**	**5.6E-03**	**4.9E-03**	**4.8E-03**	**4.8E-03**	**4.7E-03**	**4.7E-03**	**4.7E-03**	**4.7E-03**	**4.7E-03**
Internal	5.9E-03	4.9E-03	4.8E-03	4.7E-03	4.7E-03	4.7E-03	4.6E-03	4.6E-03	4.6E-03	4.6E-03
External	6.7E-03	7.4E-04	1.6E-04	1.0E-04	9.6E-05	9.6E-05	9.7E-05	9.7E-05	9.8E-05	9.8E-05

INFORMATION CLEARANCE REVIEW AND RELEASE APPROVAL

Part I: Background Information

Title: Retrieval Data Report for Single-Shell Tank 241-C-203

Publish to OSTI? ☐ Yes ☑ No

Information Category:
☐ Abstract ☐ Journal Article ☐ Summary
☐ Internet ☐ Visual Aid ☐ Software
☐ Full Paper ☐ Report ☑ Other WMA C Closure WIR Evaluation Reference

Trademark/Copyright "Right to Use" Information or Permission Documentation	Yes	NA
	☐	☑

Document Number: RPP-RPT-26475 Revision 1-A Date: January 2008

Author: Darling, David (Dave) B

Part II: External/Public Presentation Information

Conference Name:

Sponsoring Organization(s): Rebecca Blackwell

Date of Conference: Conference Location:

Will Material be Handed Out? ☐ Yes ☑ No Will Information be Published? ☐ Yes ☑ No *(If Yes, attach copy of Conference format instructions/guidance.)*

Part III: WRPS Document Originator Checklist

Description	*Yes*	*N/A*	*Print/Sign/Date*
Information Product meets requirements in TFC-BSM-AD-C-01?	☐	☑	
Document Release Criteria in TFC-ENG-DESIGN-C-25 completed? (Attach checklist)	☐	☑	
If product contains pictures, safety review completed?	☐	☑	

Part IV: WRPS Internal Review

Function	*Organization*	*Date*	*Print Name/Signature/Date*
Subject Matter Expert	WRPS	01/06/2025	Darling, David (Dave) B Approved - IDMS data file att.
Responsible Manager	WRPS	12/23/2024	Levitt, Marc T Approved - IDMS data file att.
Other:			

Part V: IRM Clearance Services Review

Description	*Yes*	*No*	*Print Name/Signature*
Document Contains Classified Information?	☐	☒	If Answer is "Yes," ADC Approval Required Print Name/Signature/Date
Document Contains Information Restricted by DOE Operational Security Guidelines?	☐	☒	Reviewer Signature: Print Name/Signature/Date
Document is Subject to Release Restrictions? *If the answer is "Yes," please mark category at right and describe limitation or responsible organization below:*	☐	☒	Document contains: ☐ Applied Technology ☐ Protected CRADA ☐ Personal/Private ☐ Export Controlled ☐ Proprietary ☐ Procurement – Sensitive ☐ Patentable Info. ☐ OUO ☐ Predecisional Info. ☐ UCNI ☐ Restricted by Operational Security Guidelines ☐ Other (Specify)
Additional Comments from Information Clearance Specialist Review?	☐	☒	Information Clearance Specialist Approval APPROVED By Heather Moyer at 9:56 am, Jan 07, 2025 Print Name/Signature/Date

When IRM Clearance Review is Complete – Return to WRPS Originator for Final Signature Routing (Part VI)

INFORMATION CLEARANCE REVIEW AND RELEASE APPROVAL

Part VI: Final Review and Approvals

Description	*Approved for Release*		*Print Name/Signature*	
	Yes	*N/A*		
WRPS External Affairs	☒	☐	Roberts, Jennifer L	Approved - IDMS data file att.
WRPS Office of Chief Counsel	☒	☐	Kneese, Kyle C	Approved - IDMS data file att.
DOE – ORP Public Affairs/Communications	☒	☐	Dawson, Edward M	Approved - IDMS data file att.
Other: DOE SME	☒	☐	Millikin, Emily J	Approved - IDMS data file att.
Other:	☐	☐		

Comments Required for WRPS-Indicate Purpose of Document:

Reference for WMA C Closure WIR Evaluation that will be put into Hanford Administrative Record.

APPROVED
By Heather Moyer at 9:57 am, Jan 07, 2025

Approved for Public Release; Further Dissemination Unlimited

Information Release Station

Was/Is Information Product Approved for Release? ☒ Yes ☐ No

If Yes, what is the Level of Releaser? ☑ Public/Unrestricted ☐ Other (Specify) _____

Date Information Product Stamped/Marked for Release: 01/07/2025

Was/Is Information Product Transferred to OSTI? ☐ Yes ☒ No

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  performer-id="251931195" username="h3232316">
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    203 Rev 1-A, submitted by David B. Darling for public release. Released in SPF/IDMS on
    01/16/2008, edits require revision. Thank you, Heather Moyer Information Clearance</comments>
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