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Engineering Design File

WM-183 Tank Solid and Liquid Volume Estimates and Radionuclide Inventories at Closure with Comparisons to Performance Assessment Modeling Results

Portage Project No.: 2121.00
Project Title: Tank Farm Inventory Estimate for WM-183

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3. Subtask: Tank Inventory Estimates for WM-183

4. Title: WM-183 Tank Solid and Liquid Volume Estimates and Radionuclide Inventories at Closure with Comparisons to Performance Assessment Modeling Results

5. Summary:

This Engineering Design File estimates the post-decontamination volume of residual solids and interstitial liquids in Tank WM-183 and provides the radionuclide inventory at closure. The depth of the residual solids was estimated from videos of the tank floor and the solids volume was estimated through krieging algorithms using Surfer 8 software. The residual liquid volume was estimated based on 1 in. of liquid as indicated by the post-decontamination tank video. Total radionuclide inventories were calculated based on these estimated volumes of residual solids and liquids and laboratory results for post-decontamination samples taken from the tank, and decayed to 2012. The inventory at closure is compared to the inventory used in the Tank Farm Performance Assessment along with new public dose estimates for the inventory at closure.

6. Distribution: (Portage Environmental, Inc.)

Kerry Martin

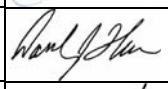
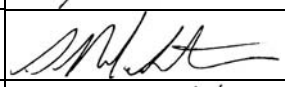
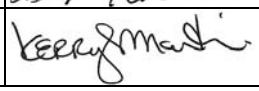
Keith Quigley (CWI)

E. Kirk Roemer

Nick Stanisich, CIH

David J. Thorne, CHP

7. Review (R) and Approval (A) Signatures:
(Identify minimum reviews and approvals. Additional reviews/approvals may be added.)

	R/A	Printed Name/ Organization	Signature	Date
Author	A	E. Kirk Roemer		12-22-05
Author	A	David J. Thorne, CHP		12-22-05
Independent Review	R	Nick Stanisich, CIH		12-22-05
Project Manager	R/A	Kerry Martin		12-22-05

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ACRONYMS

EDF	engineering design file
MDA	minimum detectable activity
PA	performance assessment
UCL	upper confidence limit

1. INTRODUCTION AND PURPOSE

The purpose of this Engineering Design File (EDF) is to estimate the volume of solids and interstitial liquids left after cleaning and removal techniques were completed. Post-decontamination tank residual solid and liquid volume estimates were recommended by the Nuclear Regulatory Commission for future tank closure activities (Essig 2002).

The method used to estimate the residual tank solid volumes included reviewing videos from the most current tank cleaning sessions, estimating the depths of solids based on cooling coil brackets and welds, krieging the estimated solids depths from the video with Surfer 8 software and using this volume estimate to determine solids radionuclide activities in the tanks after decontamination operations. Post-decontamination radionuclide activities were decayed to 2012 to appropriately represent the radionuclide inventory at closure. Because the steam jets have been lowered to 0.375 in. (0.95 cm) above the tank bottoms, the residual liquid volume was based on an estimated 1 in. (2.54 cm) of liquids remaining after decontamination operations.

1.1 Video Interpretation

Tank volume estimates for Tank WM-183 for the solid waste and interstitial water were first created by viewing the video titled: "INEEL: WM-183 12/10/02 Nozzle Camera after Washing" (Quigley 2002). Other videotapes from Tank WM-183 were used to augment estimates from areas that could not be determined from the primary video. These videotapes were taken during and after sampling and cleaning events.

Residual solid waste depths were estimated from the videos by comparing the solids depths to the cooling coil support brackets and associated welds. Assumptions of depth were based on the bottom weld and stainless steel bracket thickness measuring 0.38 in. (0.96 cm). Close-ups from the video were critical in determining depth of waste next to the brackets and areas where no apparent solid residuals were observed. Depths of solid waste ranged from 0–0.5 in. (0–1.27 cm). Areas where no solid results were present on the bottom of the tank were apparent by the reflection from the stainless steel bottom.

1.2 Surfer Krieging

Residual solids depth measurements were recorded and entered into an AutoCAD 2004 drawing in association with the cooling coil support locations. Cartesian coordinates (x and y) were determined for each cooling coil support and associated residual depth measurement. The residual solids depth data and associated Cartesian coordinates for the cooling coil supports were then exported to Surfer 8 software.

The residual solids volume was estimated using krieging methods in Surfer 8 software, with *point - krieging* being the preferred gridding method. A simple variogram model was used with linear interpretation using a slope equal to 1.0 and anisotropy equal to one.

Contour, post, and surface plot maps are provided for the residual solids volume estimates in Figure 1. Residual solid volume estimates were determined using Surfer 8 software

with 0 in. (0 cm) as a lower surface boundary and the Trapezoid Rule as the preferred volume estimate method (see Table 1).

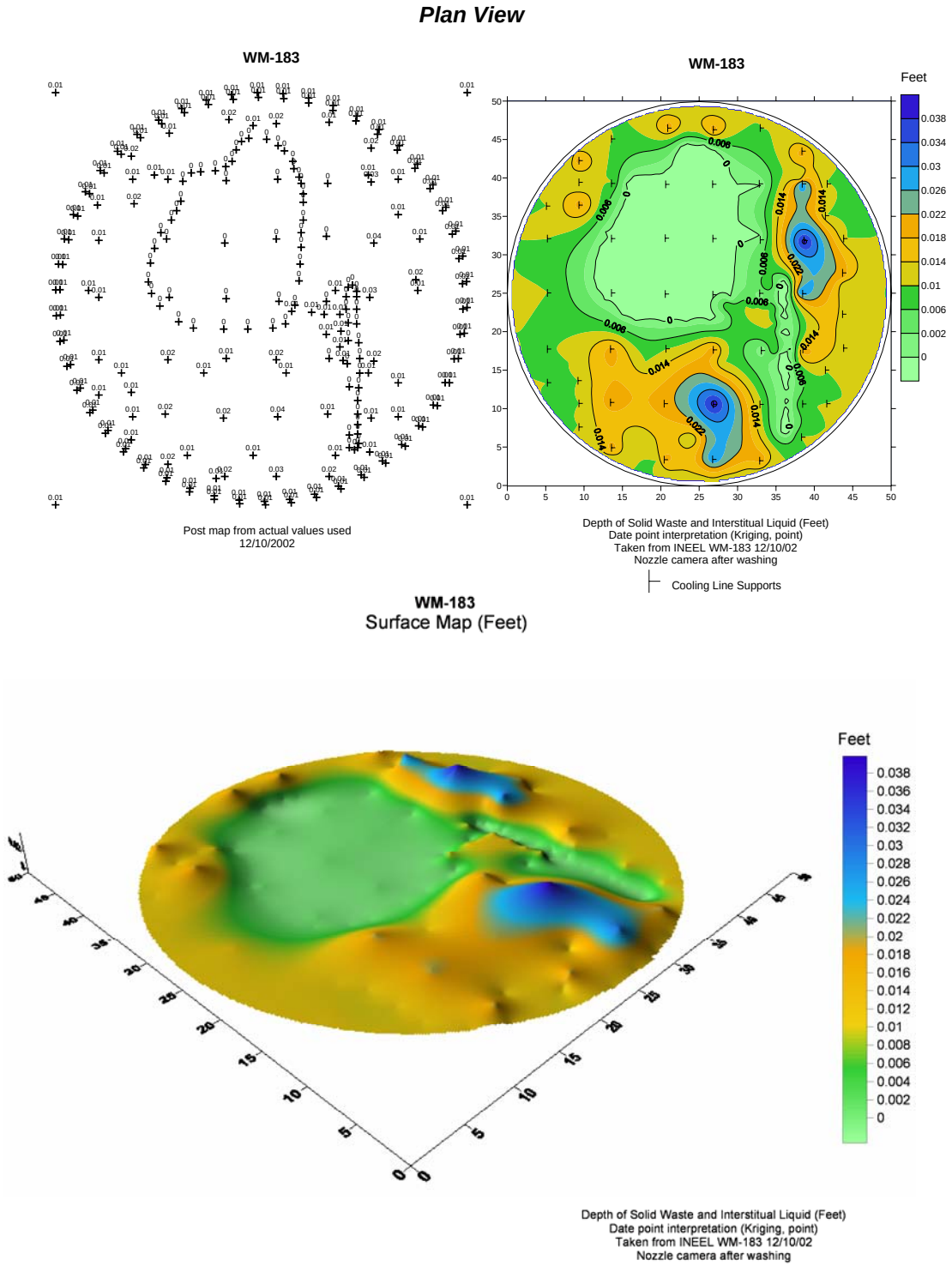

Figure 1. Surface contours showing residual solids depth in Tank WM-183.

Table 1. Residual solids volume computations from Surfer 8 software.

Thu May 29 11:42:22 2003

Upper Surface

Grid File Name:	C:\Documents and Settings\Edward K. Roemer\My Documents\PORTAGE_docs\tank_study\Actual_video_data183_wblank.grd
Grid Size:	333 rows x 333 columns
X Minimum:	0 ft
X Maximum:	50 ft
X Spacing:	0.15060240963855 ft
Y Minimum:	0 ft
Y Maximum:	50 ft
Y Spacing:	0.15060240963855 ft
Z Minimum:	-0.0027750739258654 ft
Z Maximum:	0.03988987485213 ft

Lower Surface

Level Surface defined by Z = 0 ft

Volumes

Z Scale Factor:	1 ft

Total Volumes by:

Trapezoidal Rule:	17.70053488818 ft^3 501.2233 L
Simpson's Rule:	17.710397171045 ft^3 501.5026 L
Simpson's 3/8 Rule:	17.692067519817 ft^3 500.9836 L

Depth of liquid above the interstitial waste was estimated to be approximately 1 in. by comparison to the height of the sump lines in the post-decontamination video. The tank construction limits the removal of all liquid, even with the jets located at the tank bottom.

1.3 Radionuclide Activity Calculations

A summary of the sample data for Tank WM-183 for liquids is provided in Table 2. The liquid sample data are provided in Attachment 1. The 95% upper confidence limit (UCL) of the mean was used for the inventory from the sample data if four or more detections were obtained for a radionuclide with "U"-flagged data being assigned a value of one-half the minimum detectable activity (MDA). Radionuclide sample data sets with less than four detections were assigned the highest value recorded for a particular radionuclide. Radionuclides reported in the original

sample database with half-lives of less than two years were assumed to be anomalies and were not incorporated into the tank inventories.

A summary of the solid sample data from Tank WM-183 is provided in Table 3. The solids sample data are provided in Attachment 2. Two solids sampling events occurred for Tank WM-183. The highest detected concentration for a radionuclide in the two data sets was selected for use in estimating the tank inventory for solids. Radionuclides reported in the solids sample database with half-lives of less than two years were assumed to be anomalies and were not incorporated into the tank inventories.

Table 2. Summary of post-decontamination concentrations of radionuclides in liquid.

Nuclide[a]	Mean (pCi/L)	95% UCL or Maximum[b] (pCi/L)	95% UCL or Maximum[b] (Ci/L)
^{241}Am	1.83E+05	1.97E+05	1.97E-07
^{14}C	[c]	1.72E+01	1.72E-11
^{244}Cm	3.81E+03	4.58E+03	4.58E-09
^{60}Co	[c]	8.69E+03	8.69E-09
^{137}Cs	7.59E+07	1.03E+08	1.03E-04
^{154}Eu	[c]	1.29E+04	1.29E-08
^{3}H	5.27E+05	6.43E+05	6.43E-07
^{129}I	1.22E+03	1.53E+03	1.53E-09
^{94}Nb	[c]	1.09E+04	1.09E-08
^{63}Ni	2.54E+05	3.02E+05	3.02E-07
^{237}Np	2.56E+03	3.12E+03	3.12E-09
^{238}Pu	6.63E+05	1.03E+06	1.03E-06
^{239}Pu	2.18E+05	3.37E+05	3.37E-07
^{241}Pu	1.01E+05	1.35E+05	1.35E-07
^{125}Sb	[c]	3.18E+05	3.18E-07
^{90}Sr	6.94E+08	8.70E+08	8.70E-04
^{99}Tc	1.10E+03	1.75E+03	1.75E-09
^{234}U	1.32E+03	1.64E+03	1.64E-09
^{235}U	7.01E+01	1.06E+02	1.06E-10
^{238}U	[c]	7.40E+01	7.40E-11

a. Several radionuclides were eliminated from analysis (see table footnote in Attachment 1).

b. Maximum value used if number of sample detections was less than 4.

c. Less than four true detections; therefore, mean was not calculated.

Table 3. Summary of solid sample results for Tank WM-183.

Nuclide[a]	pCi/g	Ci/kg
^{241}Am	3.40E+05	3.40E-04
^{60}Co	1.87E+05	1.87E-04
^{137}Cs	1.19E+09	1.19E+00
^{94}Nb	1.66E+05	1.66E-04
^{238}Pu	9.99E+06	9.99E-03
^{239}Pu	2.75E+06	2.75E-03
^{125}Sb	6.78E+06	6.78E-03
^{90}Sr	2.39E+07	2.39E-02
^{234}U	2.98E+03	2.98E-06

a. Several radionuclides were eliminated from analysis (see table footnote in Attachment 2).

The estimated radionuclide inventory for Tank WM-183 is provided in Table 4. The radionuclide inventory in Tank WM-183 for liquids, post-decontamination, was estimated based upon the sample data provided in Table 2 and the estimated residual liquid volume of 4,989 L (i.e., 1 in. of residual liquid). Concentrations of radionuclides for which there was no sampling data were based upon the original normalized inventory concentrations (i.e., ORIGEN2 [Croff 1980] analyses by Wenzel [2005]) presented in the Tank Farm Performance Assessment (PA) (DOE-ID 2003). The ORIGEN2 normalized concentrations (Wenzel 2005) were then adjusted according to the measured ^{137}Cs activity (i.e., 1.03E-3 Ci/L), decayed to 2012, and the estimated residual liquid volume of 4,989 L.

The radionuclide inventory at closure in Tank WM-183 for solids was estimated based upon the sample data provided in Table 3 and the estimated residual solid volume of 501 L provided in Table 1. The residual solid volume was converted to mass assuming a density of 1.4 g/mL, resulting in a total residual solids mass of 702 kg in Tank WM-183. Concentrations of radionuclides for which there was no sample data, were based upon the original normalized inventory concentrations (i.e., ORIGEN2 [Croff 1980] analyses by Wenzel [2005]) presented in the Tank Farm PA (DOE-ID 2003). The ORIGEN2 normalized concentrations were not adjusted according to the measured ^{137}Cs activity (i.e., 1.19 Ci/kg), instead, the original ratio of 1.8 was used in the calculations for conservatism. The difference in the inventory for solids between using a 1.19 and 1.8 ^{137}Cs ratio is than a 1 percent in the solids inventory. This is due to the large percentage of the inventory being represented by ^{137}Cs/^{137m}Ba, ^{90}Sr/^{90}Y, and the measured plutonium isotopes. The solid inventories for these radionuclides were measured in the sample and are not affected by the ^{137}Cs ratio assumed in the analysis.

Table 4. Estimated Radionuclide Inventory for Tank WM-183.

Solids					Liquids					Total (solid + liquid)	
Nuclide	ORIGEN2[a,e]	^{137}Cs Ratio Factor[c]	(Ci/kg)	Total Solids Activity (Ci)	Nuclide	ORIGEN2[a,e]	^{137}Cs Ratio Factor	Ci/L	Total Liquids Activity (Ci)	Total Tank Activity (Ci)	Percent Total Activity
^{225}Ac	5.61E-12	1.8	1.01E-11	7.08E-09	^{225}Ac	5.61E-12	8.38E-05	4.70E-16	2.34E-12	7.09E-09	0.00%
^{227}Ac	1.20E-09	1.8	2.15E-09	1.51E-06	^{227}Ac	1.20E-09	8.38E-05	1.00E-13	5.00E-10	1.51E-06	0.00%
^{228}Ac	1.73E-14	1.8	3.11E-14	2.18E-11	^{228}Ac	1.73E-14	8.38E-05	1.45E-18	7.22E-15	2.18E-11	0.00%
^{108}Ag	2.85E-13	1.8	5.13E-13	3.60E-10	^{108}Ag	2.85E-13	8.38E-05	2.39E-17	1.19E-13	3.60E-10	0.00%
^{108m}Ag	3.20E-12	1.8	5.76E-12	4.04E-09	^{108m}Ag	3.20E-12	8.38E-05	2.68E-16	1.34E-12	4.05E-09	0.00%
^{109m}Ag	2.38E-17	1.8	4.28E-17	3.00E-14	^{109m}Ag	2.38E-17	8.38E-05	1.99E-21	9.94E-18	3.00E-14	0.00%
^{110}Ag	8.93E-19	1.8	1.61E-18	1.13E-15	^{110}Ag	8.93E-19	8.38E-05	7.48E-23	3.73E-19	1.13E-15	0.00%
^{110m}Ag	6.71E-17	1.8	1.21E-16	8.48E-14	^{110m}Ag	6.71E-17	8.38E-05	5.63E-21	2.81E-17	8.48E-14	0.00%
^{241}Am	[b]		3.40E-04	2.39E-01	^{241}Am	[d]		1.94E-07	9.68E-04	2.40E-01	0.02%
^{242}Am	7.13E-07	1.8	1.28E-06	9.01E-04	^{242}Am	7.13E-07	8.38E-05	5.98E-11	2.98E-07	9.01E-04	0.00%
^{242m}Am	7.17E-07	1.8	1.29E-06	9.06E-04	^{242m}Am	7.17E-07	8.38E-05	6.01E-11	3.00E-07	9.06E-04	0.00%
^{243}Am	9.83E-07	1.8	1.77E-06	1.24E-03	^{243}Am	9.83E-07	8.38E-05	8.24E-11	4.11E-07	1.24E-03	0.00%
^{217}At	5.61E-12	1.8	1.01E-11	7.08E-09	^{217}At	5.61E-12	8.38E-05	4.70E-16	2.34E-12	7.09E-09	0.00%
^{137m}Ba	[b]		9.20E-01	6.46E+02	^{137m}Ba	[d]		8.38E-05	4.18E-01	6.46E+02	47.39%
^{10}Be	7.56E-11	1.8	1.36E-10	9.55E-08	^{10}Be	7.56E-11	8.38E-05	6.34E-15	3.16E-11	9.56E-08	0.00%
^{210}Bi	1.11E-10	1.8	2.01E-10	1.41E-07	^{210}Bi	1.11E-10	8.38E-05	9.34E-15	4.66E-11	1.41E-07	0.00%
^{210m}Bi	5.41E-24	1.8	9.75E-24	6.84E-21	^{210m}Bi	5.41E-24	8.38E-05	4.54E-28	2.26E-24	6.84E-21	0.00%
^{211}Bi	1.20E-09	1.8	2.16E-09	1.51E-06	^{211}Bi	1.20E-09	8.38E-05	1.00E-13	5.01E-10	1.51E-06	0.00%
^{212}Bi	7.18E-08	1.8	1.29E-07	9.07E-05	^{212}Bi	7.18E-08	8.38E-05	6.02E-12	3.00E-08	9.08E-05	0.00%
^{213}Bi	5.61E-12	1.8	1.01E-11	7.08E-09	^{213}Bi	5.61E-12	8.38E-05	4.70E-16	2.34E-12	7.09E-09	0.00%
^{214}Bi	2.88E-10	1.8	5.18E-10	3.63E-07	^{214}Bi	2.88E-10	8.38E-05	2.41E-14	1.20E-10	3.63E-07	0.00%
^{14}C	2.20E-09	1.8	3.96E-09	2.78E-06	^{14}C	[d]		1.72E-11	8.58E-08	2.86E-06	0.00%
^{109}Cd	2.38E-17	1.8	4.28E-17	3.00E-14	^{109}Cd	2.38E-17	8.38E-05	1.99E-21	9.94E-18	3.00E-14	0.00%
^{113m}Cd	5.78E-05	1.8	1.04E-04	7.30E-02	^{113m}Cd	5.78E-05	8.38E-05	4.84E-09	2.42E-05	7.30E-02	0.01%
^{142}Ce	7.31E-10	1.8	1.32E-09	9.24E-07	^{142}Ce	7.31E-10	8.38E-05	6.13E-14	3.06E-10	9.24E-07	0.00%
^{144}Ce	2.33E-10	1.8	4.19E-10	2.94E-07	^{144}Ce	2.33E-10	8.38E-05	1.95E-14	9.73E-11	2.94E-07	0.00%
^{249}Cf	7.21E-16	1.8	1.30E-15	9.10E-13	^{249}Cf	7.21E-16	8.38E-05	6.04E-20	3.01E-16	9.10E-13	0.00%
^{250}Cf	3.73E-16	1.8	6.71E-16	4.71E-13	^{250}Cf	3.73E-16	8.38E-05	3.12E-20	1.56E-16	4.71E-13	0.00%
^{251}Cf	1.14E-17	1.8	2.06E-17	1.44E-14	^{251}Cf	1.14E-17	8.38E-05	9.57E-22	4.78E-18	1.44E-14	0.00%

Table 4. (continued).

Solids					Liquids						Total (solid + liquid)
Nuclide	ORIGEN2[a,e]	^{137}Cs Ratio Factor[c]	(Ci/kg)	Total Solids Activity (Ci)	Nuclide	ORIGEN2[a,e]	^{137}Cs Ratio Factor	Ci/L	Total Liquids Activity (Ci)	Total Tank Activity (Ci)	Percent Total Activity
^{252}Cf	4.84E-19	1.8	8.72E-19	6.12E-16	^{252}Cf	4.84E-19	8.38E-05	4.06E-23	2.02E-19	6.12E-16	0.00%
^{242}Cm	5.91E-07	1.8	1.06E-06	7.47E-04	^{242}Cm	5.91E-07	8.38E-05	4.96E-11	2.47E-07	7.47E-04	0.00%
^{243}Cm	1.29E-07	1.8	2.31E-07	1.62E-04	^{243}Cm	1.29E-07	8.38E-05	1.08E-11	5.37E-08	1.62E-04	0.00%
^{244}Cm	7.03E-06	1.8	1.27E-05	8.88E-03	^{244}Cm	[d]		3.25E-09	1.62E-05	8.90E-03	0.00%
^{245}Cm	1.68E-09	1.8	3.02E-09	2.12E-06	^{245}Cm	1.68E-09	8.38E-05	1.41E-13	7.02E-10	2.12E-06	0.00%
^{246}Cm	1.10E-10	1.8	1.98E-10	1.39E-07	^{246}Cm	1.10E-10	8.38E-05	9.23E-15	4.61E-11	1.39E-07	0.00%
^{247}Cm	1.22E-16	1.8	2.20E-16	1.54E-13	^{247}Cm	1.22E-16	8.38E-05	1.02E-20	5.10E-17	1.54E-13	0.00%
^{248}Cm	1.29E-16	1.8	2.32E-16	1.63E-13	^{248}Cm	1.29E-16	8.38E-05	1.08E-20	5.38E-17	1.63E-13	0.00%
^{60}Co	[b]		5.02E-05	3.52E-02	^{60}Co	[d]		2.66E-09	1.33E-05	3.52E-02	0.00%
^{134}Cs	3.03E-05	1.8	5.46E-05	3.83E-02	^{134}Cs	3.03E-05	8.38E-05	2.54E-09	1.27E-05	3.83E-02	0.00%
^{135}Cs	1.44E-05	1.8	2.59E-05	1.82E-02	^{135}Cs	1.44E-05	8.38E-05	1.21E-09	6.01E-06	1.82E-02	0.00%
^{137}Cs	[b]		9.20E-01	6.46E+02	^{137}Cs	[d]		8.38E-05	4.18E-01	6.46E+02	47.39%
^{150}Eu	2.96E-10	1.8	5.34E-10	3.74E-07	^{150}Eu	2.96E-10	8.38E-05	2.48E-14	1.24E-10	3.75E-07	0.00%
^{152}Eu	3.92E-05	1.8	7.05E-05	4.95E-02	^{152}Eu	3.92E-05	8.38E-05	3.28E-09	1.64E-05	4.95E-02	0.00%
^{154}Eu	1.75E-03	1.8	3.15E-03	2.21E+00	^{154}Eu	[d]		6.35E-09	3.17E-05	2.21E+00	0.16%
^{155}Eu	4.74E-04	1.8	8.53E-04	5.98E-01	^{155}Eu	4.74E-04	8.38E-05	3.97E-08	1.98E-04	5.98E-01	0.04%
^{55}Fe	4.88E-04	1.8	8.79E-04	6.16E-01	^{55}Fe	4.88E-04	8.38E-05	4.09E-08	2.04E-04	6.17E-01	0.05%
^{221}Fr	5.61E-12	1.8	1.01E-11	7.08E-09	^{221}Fr	5.61E-12	8.38E-05	4.70E-16	2.34E-12	7.09E-09	0.00%
^{223}Fr	1.65E-11	1.8	2.97E-11	2.08E-08	^{223}Fr	1.65E-11	8.38E-05	1.38E-15	6.90E-12	2.08E-08	0.00%
^{152}Gd	3.58E-17	1.8	6.44E-17	4.52E-14	^{152}Gd	3.58E-17	8.38E-05	3.00E-21	1.50E-17	4.52E-14	0.00%
^{153}Gd	4.15E-19	1.8	7.48E-19	5.25E-16	^{153}Gd	4.15E-19	8.38E-05	3.48E-23	1.74E-19	5.25E-16	0.00%
^{3}H	3.22E-04	1.8	5.79E-04	4.06E-01	^{3}H	[d]		3.87E-07	1.93E-03	4.08E-01	0.03%
^{166m}Ho	1.13E-09	1.8	2.03E-09	1.42E-06	^{166m}Ho	1.13E-09	8.38E-05	9.44E-14	4.71E-10	1.42E-06	0.00%
^{129}I	[b]		6.24E-07	4.38E-04	^{129}I	[d]		1.53E-09	7.63E-06	4.46E-04	0.00%
^{115}In	2.75E-16	1.8	4.95E-16	3.47E-13	^{115}In	2.75E-16	8.38E-05	2.30E-20	1.15E-16	3.48E-13	0.00%
^{138}La	4.68E-15	1.8	8.43E-15	5.92E-12	^{138}La	4.68E-15	8.38E-05	3.93E-19	1.96E-15	5.92E-12	0.00%
^{93m}Nb	8.74E-05	1.8	1.57E-04	1.10E-01	^{93m}Nb	8.74E-05	8.38E-05	7.32E-09	3.65E-05	1.10E-01	0.01%
^{94}Nb	[b]		1.66E-04	1.16E-01	^{94}Nb	[d]		1.09E-08	5.44E-05	1.17E-01	0.01%
^{144}Nd	3.96E-14	1.8	7.14E-14	5.01E-11	^{144}Nd	3.96E-14	8.38E-05	3.32E-18	1.66E-14	5.01E-11	0.00%
^{59}Ni	1.13E-05	1.8	2.03E-05	1.42E-02	^{59}Ni	1.13E-05	8.38E-05	9.44E-10	4.71E-06	1.42E-02	0.00%
^{63}Ni	1.28E-03	1.8	2.31E-03	1.62E+00	^{63}Ni	[d]		2.84E-07	1.42E-03	1.62E+00	0.12%

Table 4. (continued).

Solids					Liquids						Total (solid + liquid)
Nuclide	ORIGEN2[a,e]	^{137}Cs Ratio Factor[c]	(Ci/kg)	Total Solids Activity (Ci)	Nuclide	ORIGEN2[a,e]	^{137}Cs Ratio Factor	Ci/L	Total Liquids Activity (Ci)	Total Tank Activity (Ci)	Percent Total Activity
^{236}Np	2.21E-10	1.8	3.97E-10	2.79E-07	^{236}Np	2.21E-10	8.38E-05	1.85E-14	9.22E-11	2.79E-07	0.00%
^{237}Np	2.11E-05	1.8	3.80E-05	2.67E-02	^{237}Np	[d]		3.12E-09	1.56E-05	2.67E-02	0.00%
^{238}Np	3.58E-09	1.8	6.45E-09	4.53E-06	^{238}Np	3.58E-09	8.38E-05	3.00E-13	1.50E-09	4.53E-06	0.00%
^{239}Np	9.83E-07	1.8	1.77E-06	1.24E-03	^{239}Np	9.83E-07	8.38E-05	8.24E-11	4.11E-07	1.24E-03	0.00%
^{240m}Np	2.94E-14	1.8	5.28E-14	3.71E-11	^{240m}Np	2.94E-14	8.38E-05	2.46E-18	1.23E-14	3.71E-11	0.00%
^{231}Pa	2.12E-09	1.8	3.82E-09	2.68E-06	^{231}Pa	2.12E-09	8.38E-05	1.78E-13	8.87E-10	2.68E-06	0.00%
^{233}Pa	2.11E-05	1.8	3.80E-05	2.67E-02	^{233}Pa	2.11E-05	8.38E-05	1.77E-09	8.82E-06	2.67E-02	0.00%
^{234}Pa	1.06E-09	1.8	1.91E-09	1.34E-06	^{234}Pa	1.06E-09	8.38E-05	8.89E-14	4.44E-10	1.34E-06	0.00%
^{234m}Pa	8.17E-07	1.8	1.47E-06	1.03E-03	^{234m}Pa	8.17E-07	8.38E-05	6.84E-11	3.41E-07	1.03E-03	0.00%
^{209}Pb	5.61E-12	1.8	1.01E-11	7.08E-09	^{209}Pb	5.61E-12	8.38E-05	4.70E-16	2.34E-12	7.09E-09	0.00%
^{210}Pb	1.11E-10	1.8	2.01E-10	1.41E-07	^{210}Pb	1.11E-10	8.38E-05	9.34E-15	4.66E-11	1.41E-07	0.00%
^{211}Pb	1.20E-09	1.8	2.16E-09	1.51E-06	^{211}Pb	1.20E-09	8.38E-05	1.00E-13	5.01E-10	1.51E-06	0.00%
^{212}Pb	7.18E-08	1.8	1.29E-07	9.07E-05	^{212}Pb	7.18E-08	8.38E-05	6.02E-12	3.00E-08	9.08E-05	0.00%
^{214}Pb	2.88E-10	1.8	5.18E-10	3.63E-07	^{214}Pb	2.88E-10	8.38E-05	2.41E-14	1.20E-10	3.63E-07	0.00%
^{107}Pd	4.06E-07	1.8	7.31E-07	5.13E-04	^{107}Pd	4.06E-07	8.38E-05	3.40E-11	1.70E-07	5.13E-04	0.00%
^{146}Pm	4.00E-07	1.8	7.20E-07	5.05E-04	^{146}Pm	4.00E-07	8.38E-05	3.35E-11	1.67E-07	5.05E-04	0.00%
^{147}Pm	3.88E-04	1.8	6.99E-04	4.91E-01	^{147}Pm	3.88E-04	8.38E-05	3.25E-08	1.62E-04	4.91E-01	0.04%
^{210}Po	1.08E-10	1.8	1.94E-10	1.36E-07	^{210}Po	1.08E-10	8.38E-05	9.02E-15	4.50E-11	1.36E-07	0.00%
^{211}Po	3.35E-12	1.8	6.04E-12	4.24E-09	^{211}Po	3.35E-12	8.38E-05	2.81E-16	1.40E-12	4.24E-09	0.00%
^{212}Po	4.60E-08	1.8	8.29E-08	5.81E-05	^{212}Po	4.60E-08	8.38E-05	3.86E-12	1.92E-08	5.82E-05	0.00%
^{213}Po	5.49E-12	1.8	9.88E-12	6.93E-09	^{213}Po	5.49E-12	8.38E-05	4.60E-16	2.29E-12	6.93E-09	0.00%
^{214}Po	2.87E-10	1.8	5.17E-10	3.63E-07	^{214}Po	2.87E-10	8.38E-05	2.41E-14	1.20E-10	3.63E-07	0.00%
^{215}Po	1.20E-09	1.8	2.16E-09	1.51E-06	^{215}Po	1.20E-09	8.38E-05	1.00E-13	5.01E-10	1.51E-06	0.00%
^{216}Po	7.18E-08	1.8	1.29E-07	9.07E-05	^{216}Po	7.18E-08	8.38E-05	6.02E-12	3.00E-08	9.08E-05	0.00%
^{218}Po	2.88E-10	1.8	5.18E-10	3.63E-07	^{218}Po	2.88E-10	8.38E-05	2.41E-14	1.20E-10	3.63E-07	0.00%
^{144}Pr	2.33E-10	1.8	4.19E-10	2.94E-07	^{144}Pr	2.33E-10	8.38E-05	1.95E-14	9.73E-11	2.94E-07	0.00%
^{144m}Pr	2.79E-12	1.8	5.03E-12	3.53E-09	^{144m}Pr	2.79E-12	8.38E-05	2.34E-16	1.17E-12	3.53E-09	0.00%
^{236}Pu	6.52E-09	1.8	1.17E-08	8.24E-06	^{236}Pu	6.52E-09	8.38E-05	5.47E-13	2.73E-09	8.24E-06	0.00%
^{238}Pu	[b]		9.23E-03	6.48E+00	^{238}Pu	[d]		9.59E-07	4.78E-03	6.48E+00	0.48%
^{239}Pu	[b]		2.75E-03	1.93E+00	^{239}Pu	[d]		3.37E-07	1.68E-03	1.93E+00	0.14%
^{240}Pu	6.06E-04	1.8	1.09E-03	7.65E-01	^{240}Pu	6.06E-04	8.38E-05	5.08E-08	2.53E-04	7.66E-01	0.06%

Table 4. (continued).

Solids					Liquids						Total (solid + liquid)
Nuclide	ORIGEN2[a,e]	^{137}Cs Ratio Factor[c]	(Ci/kg)	Total Solids Activity (Ci)	Nuclide	ORIGEN2[a,e]	^{137}Cs Ratio Factor	Ci/L	Total Liquids Activity (Ci)	Total Tank Activity (Ci)	Percent Total Activity
^{241}Pu	8.75E-03	1.8	1.58E-02	1.11E+01	^{241}Pu	[d]		8.75E-08	4.37E-04	1.11E+01	0.81%
^{242}Pu	4.43E-07	1.8	7.98E-07	5.60E-04	^{242}Pu	4.43E-07	8.38E-05	3.71E-11	1.85E-07	5.60E-04	0.00%
^{243}Pu	1.22E-16	1.8	2.20E-16	1.54E-13	^{243}Pu	1.22E-16	8.38E-05	1.02E-20	5.10E-17	1.54E-13	0.00%
^{244}Pu	2.94E-14	1.8	5.29E-14	3.71E-11	^{244}Pu	2.94E-14	8.38E-05	2.46E-18	1.23E-14	3.71E-11	0.00%
^{223}Ra	1.20E-09	1.8	2.16E-09	1.51E-06	^{223}Ra	1.20E-09	8.38E-05	1.00E-13	5.01E-10	1.51E-06	0.00%
^{224}Ra	7.18E-08	1.8	1.29E-07	9.07E-05	^{224}Ra	7.18E-08	8.38E-05	6.02E-12	3.00E-08	9.08E-05	0.00%
^{225}Ra	5.61E-12	1.8	1.01E-11	7.08E-09	^{225}Ra	5.61E-12	8.38E-05	4.70E-16	2.34E-12	7.09E-09	0.00%
^{226}Ra	2.88E-10	1.8	5.18E-10	3.63E-07	^{226}Ra	2.88E-10	8.38E-05	2.41E-14	1.20E-10	3.63E-07	0.00%
^{228}Ra	1.73E-14	1.8	3.11E-14	2.18E-11	^{228}Ra	1.73E-14	8.38E-05	1.45E-18	7.22E-15	2.18E-11	0.00%
^{87}Rb	7.15E-10	1.8	1.29E-09	9.03E-07	^{87}Rb	7.15E-10	8.38E-05	5.99E-14	2.99E-10	9.03E-07	0.00%
^{102}Rh	2.46E-09	1.8	4.44E-09	3.11E-06	^{102}Rh	2.46E-09	8.38E-05	2.06E-13	1.03E-09	3.11E-06	0.00%
^{106}Rh	7.69E-09	1.8	1.38E-08	9.71E-06	^{106}Rh	7.69E-09	8.38E-05	6.44E-13	3.21E-09	9.71E-06	0.00%
^{219}Rn	1.20E-09	1.8	2.16E-09	1.51E-06	^{219}Rn	1.20E-09	8.38E-05	1.00E-13	5.01E-10	1.51E-06	0.00%
^{220}Rn	7.18E-08	1.8	1.29E-07	9.07E-05	^{220}Rn	7.18E-08	8.38E-05	6.02E-12	3.00E-08	9.08E-05	0.00%
^{222}Rn	2.88E-10	1.8	5.18E-10	3.63E-07	^{222}Rn	2.88E-10	8.38E-05	2.41E-14	1.20E-10	3.63E-07	0.00%
^{106}Ru	7.69E-09	1.8	1.38E-08	9.71E-06	^{106}Ru	7.69E-09	8.38E-05	6.44E-13	3.21E-09	9.71E-06	0.00%
^{125}Sb	[b]		5.55E-04	3.89E-01	^{125}Sb	[d]		3.34E-08	1.67E-04	3.90E-01	0.03%
^{126}Sb	1.41E-06	1.8	2.55E-06	1.79E-03	^{126}Sb	1.41E-06	8.38E-05	1.19E-10	5.91E-07	1.79E-03	0.00%
^{126m}Sb	1.01E-05	1.8	1.82E-05	1.28E-02	^{126m}Sb	1.01E-05	8.38E-05	8.47E-10	4.22E-06	1.28E-02	0.00%
^{79}Se	1.07E-05	1.8	1.93E-05	1.36E-02	^{79}Se	1.07E-05	8.38E-05	8.99E-10	4.49E-06	1.36E-02	0.00%
^{146}Sm	4.65E-12	1.8	8.36E-12	5.87E-09	^{146}Sm	4.65E-12	8.38E-05	3.89E-16	1.94E-12	5.87E-09	0.00%
^{147}Sm	1.81E-10	1.8	3.26E-10	2.29E-07	^{147}Sm	1.81E-10	8.38E-05	1.52E-14	7.58E-11	2.29E-07	0.00%
^{148}Sm	9.30E-16	1.8	1.67E-15	1.17E-12	^{148}Sm	9.30E-16	8.38E-05	7.79E-20	3.89E-16	1.18E-12	0.00%
^{149}Sm	8.26E-17	1.8	1.49E-16	1.04E-13	^{149}Sm	8.26E-17	8.38E-05	6.92E-21	3.45E-17	1.04E-13	0.00%
^{151}Sm	7.71E-03	1.8	1.39E-02	9.73E+00	^{151}Sm	7.71E-03	8.38E-05	6.46E-07	3.22E-03	9.74E+00	0.71%
^{119m}Sn	9.55E-15	1.8	1.72E-14	1.21E-11	^{119m}Sn	9.55E-15	8.38E-05	8.00E-19	3.99E-15	1.21E-11	0.00%
^{121m}Sn	5.74E-05	1.8	1.03E-04	7.25E-02	^{121m}Sn	5.74E-05	8.38E-05	4.81E-09	2.40E-05	7.25E-02	0.01%
^{126}Sn	1.01E-05	1.8	1.82E-05	1.28E-02	^{126}Sn	1.01E-05	8.38E-05	8.47E-10	4.22E-06	1.28E-02	0.00%
^{90}Sr	[b]		1.87E-02	1.31E+01	^{90}Sr	[d]		7.00E-04	3.49E+00	1.66E+01	1.22%
^{98}Tc	6.34E-11	1.8	1.14E-10	8.01E-08	^{98}Tc	6.34E-11	8.38E-05	5.32E-15	2.65E-11	8.02E-08	0.00%
^{99}Tc	[b]		6.17E-04	4.33E-01	^{99}Tc	[d]		1.75E-09	8.73E-06	4.33E-01	0.03%

Table 4. (continued).

Solids					Liquids						Total (solid + liquid)
Nuclide	ORIGEN2[a,e]	^{137}Cs Ratio Factor[c]	(Ci/kg)	Total Solids Activity (Ci)	Nuclide	ORIGEN2[a,e]	^{137}Cs Ratio Factor	Ci/L	Total Liquids Activity (Ci)	Total Tank Activity (Ci)	Percent Total Activity
^{123}Te	5.12E-17	1.8	9.22E-17	6.47E-14	^{123}Te	5.12E-17	8.38E-05	4.29E-21	2.14E-17	6.47E-14	0.00%
^{125m}Te	1.43E-05		1.36E-04	9.54E-02	^{125m}Te	1.43E-05	8.38E-05	1.20E-09	5.99E-06	9.54E-02	0.01%
^{227}Th	1.18E-09	1.8	2.13E-09	1.49E-06	^{227}Th	1.18E-09	8.38E-05	9.90E-14	4.94E-10	1.49E-06	0.00%
^{228}Th	7.16E-08	1.8	1.29E-07	9.05E-05	^{228}Th	7.16E-08	8.38E-05	6.00E-12	2.99E-08	9.05E-05	0.00%
^{229}Th	5.61E-12	1.8	1.01E-11	7.08E-09	^{229}Th	5.61E-12	8.38E-05	4.70E-16	2.34E-12	7.09E-09	0.00%
^{230}Th	2.35E-08	1.8	4.24E-08	2.97E-05	^{230}Th	2.35E-08	8.38E-05	1.97E-12	9.84E-09	2.97E-05	0.00%
^{231}Th	7.93E-07	1.8	1.43E-06	1.00E-03	^{231}Th	7.93E-07	8.38E-05	6.64E-11	3.31E-07	1.00E-03	0.00%
^{232}Th	1.85E-14	1.8	3.33E-14	2.34E-11	^{232}Th	1.85E-14	8.38E-05	1.55E-18	7.73E-15	2.34E-11	0.00%
^{234}Th	8.17E-07	1.8	1.47E-06	1.03E-03	^{234}Th	8.17E-07	8.38E-05	6.84E-11	3.41E-07	1.03E-03	0.00%
^{207}Tl	1.19E-09	1.8	2.15E-09	1.51E-06	^{207}Tl	1.19E-09	8.38E-05	1.00E-13	4.99E-10	1.51E-06	0.00%
^{208}Tl	2.58E-08	1.8	4.65E-08	3.26E-05	^{208}Tl	2.58E-08	8.38E-05	2.16E-12	1.08E-08	3.26E-05	0.00%
^{209}Tl	1.21E-13	1.8	2.18E-13	1.53E-10	^{209}Tl	1.21E-13	8.38E-05	1.02E-17	5.06E-14	1.53E-10	0.00%
^{171}Tm	4.80E-16	1.8	8.63E-16	6.06E-13	^{171}Tm	4.80E-16	8.38E-05	4.02E-20	2.01E-16	6.06E-13	0.00%
^{232}U	6.91E-08	1.8	1.24E-07	8.73E-05	^{232}U	6.91E-08	8.38E-05	5.79E-12	2.89E-08	8.73E-05	0.00%
^{233}U	1.77E-09	1.8	3.19E-09	2.24E-06	^{233}U	1.77E-09	8.38E-05	1.49E-13	7.42E-10	2.24E-06	0.00%
^{234}U	[b]		2.98E-06	2.09E-03	^{234}U	[d]		1.64E-09	8.18E-06	2.10E-03	0.00%
^{235}U	7.93E-07	1.8	1.43E-06	1.00E-03	^{235}U	[d]		1.06E-10	5.29E-07	1.00E-03	0.00%
^{236}U	1.85E-06	1.8	3.33E-06	2.34E-03	^{236}U	1.85E-06	8.38E-05	1.55E-10	7.73E-07	2.34E-03	0.00%
^{237}U	2.15E-07	1.8	3.86E-07	2.71E-04	^{237}U	2.15E-07	8.38E-05	1.80E-11	8.98E-08	2.71E-04	0.00%
^{238}U	8.17E-07	1.8	1.47E-06	1.03E-03	^{238}U	[d]		7.40E-11	3.69E-07	1.03E-03	0.00%
^{240}U	2.94E-14	1.8	5.28E-14	3.71E-11	^{240}U	2.94E-14	8.38E-05	2.46E-18	1.23E-14	3.71E-11	0.00%
^{90}Y	[b]		1.87E-02	1.31E+01	^{90}Y	8.88E-01	8.38E-05	7.44E-05	3.71E-01	1.35E+01	1.22%
^{93}Zr	1.06E-04	1.8	1.90E-04	1.34E-01	^{93}Zr	1.06E-04	8.38E-05	8.86E-09	4.42E-05	1.34E-01	0.01%
			Total	1355				Total	8	1363	

a. Source: Wenzel 2005 (reports nuclide to ^{137}Cs ratios based on ORIGEN2 modeling and nuclide to ^{137}Cs ratios calculated from past analytical data).
b. Measured solid sample value from WM-183 (See Attachment 2).
c. Average of ^{137}Cs data collected from the 1999 sampling of Tank WM-188.
d. Measured liquid sample from Tank WM-183.
e. From decay of parent sample data to 2012.

2. RESULTS

The total activity remaining in Tank WM-183 at closure was estimated to be 1,360 Ci, with the liquids containing 5 Ci of activity and the solids with the remaining 1,355 Ci. The conservative estimated inventory that was used in the Tank Farm PA (DOE-ID 2003) calculations contained 2.41E+04 Ci, with the solids and liquids comprising 2.21E+04 Ci and 1.97E+03 Ci, respectively. A comparison of the inventories is provided in Table 5.

Table 5. Comparison of the performance assessment inventory versus inventory a closure.

Tank Condition	Solids Activity (Ci)	Liquids Activity (Ci)	Total Tank Activity (Ci)
PA Conservative Inventory	22,100	1,970	24,100
Inventory at Closure	1,355	8	1,363

Table 6 presents a comparison of the residual radionuclide inventory at closure in WM-183 with the Tank Farm PA (DOE-ID 2003) conservative inventory for those radionuclides important to the groundwater pathway and inadvertent intruder analyses.

Table 6. Comparison of the performance assessment conservative inventory versus the estimated inventory at closure.

Radionuclide	PA Inventory (Ci)	Inventory at Closure (Ci)[c]
^{137}Cs/Ba-137m[b]	8.0E+03	1.29E+03
^{129}I[a]	2.6E-03	4.46E-04
^{94}Nb[b]	7.7E+00	1.17E-01
^{238}Pu[b]	1.7E+01	6.48E+00
^{239}Pu[b]	1.2E+00	1.93E+00
^{90}Sr/Y-90[a]	1.6E+04	3.01E+01
^{99}Tc[a]	1.0E+00	4.33E-01

a. Radionuclide important to the groundwater pathway analyses.

b. Radionuclide important to the intruder analyses.

c. Based on decay of parent sample to 2012.

The inventory at closure is lower than the projected conservative inventory used in the Tank Farm PA (DOE-ID 2003) for all radionuclides of interest except for ^{239}Pu (which is important to the intruder analysis). Since the doses calculated in the PA are directly proportional to the inventories, the doses from the PA were scaled to the new closure

inventories for the key radionuclides. The results for the groundwater drinking water dose are provided in Table 7.

Table 7. Comparison of the drinking water doses for the performance assessment inventory versus the inventory at closure.

Radionuclide	Performance Assessment Drinking Water Dose (mrem/yr)	Closure Dose Estimate (mrem/yr)
^{129}I	0.77	0.0657
$^{90}Sr/^{90}Y$	0.000002	0.00000000188
^{99}Tc	0.12	0.0248

The results indicate that the drinking water dose would decrease due to the decrease in the inventory at closure in comparison to the inventory used in the PA (DOE-ID 2003). The maximum drinking water dose for each radionuclide was found to occur at different peak times in the PA; therefore, the drinking water doses are not summed. The maximum drinking water dose is due to ^{129}I at 890 years post-closure. The maximum drinking water dose is reduced from 0.77 mrem/yr, as reported in the PA, to 0.0657 mrem/yr based on the inventory at closure. Since the PA evaluated two tanks in a north-south orientation for all groundwater analyses, this analysis assumes that the inventory in Tank WM-183 is the same as the tank located directly south, which is Tank WM-181. If the inventory at closure in WM-181 is different than WM-183 (as is expected), than the dose estimates would need to be adjusted by the total inventory for the two tanks, WM-183 and WM-181.

A comparison of the groundwater, all-pathways doses for the PA inventory and the inventory at closure is provided in Table 8.

Table 8. Comparison of the groundwater all-pathways dose for the performance assessment inventory versus inventory at closure.

Radionuclide	Performance Assessment Drinking Water Dose (mrem/yr)	Closure Dose Estimate (mrem/yr)
^{129}I	1.35	0.115
$^{90}Sr/^{90}Y$	0.00001	0.00000000941
^{99}Tc	0.87	0.18

The results indicate that the groundwater all-pathways dose would decrease due to the decrease in the inventory at closure in comparison to inventory used in the PA (DOE-ID 2003). The maximum all-pathways dose, from the groundwater pathway, for each radionuclide was found to occur at different peak times in the PA; therefore, the all-pathway doses are not summed. The maximum all-pathways dose is due to ^{129}I at 890 years post-closure. The

maximum all-pathways dose is reduced from 1.35 mrem/yr, as reported in the PA, to 0.115 mrem/yr based on the inventory at closure. Since the PA evaluated two tanks in a north-south orientation for all groundwater analyses, this analysis assumes that the inventory at closure in Tank WM-183 is the same as the tank located directly south, which is Tank WM-181. If the inventory at closure in WM-181 is different than WM-183 (as is expected), than the dose estimates would need to be adjusted by the total inventory for the two tanks, WM-183 and WM-181.

The intruder doses presented in the Tank Farm PA (DOE-ID 2003) were dominated by $^{137}Cs/^{137m}Ba$ and $^{90}Sr/^{90}Y$. Since the inventories for all radionuclides important to the intruder doses were found to be reduced in the inventory at closure, except for ^{239}Pu, the intruder doses presented in the PA would also be reduced. Although ^{239}Pu inventory was larger in the closure inventory than in the inventory used in the PA, ^{239}Pu was not a major contributor to the intruder doses. The largest contribution to intruder dose from ^{239}Pu was for the acute intruder-drilling scenario where ^{239}Pu provided 5.3 mrem. The increased ^{239}Pu inventory at closure would provide an estimated 8.2 mrem to this intruder scenario. However, $^{137}Cs/^{137m}Ba$ provided 188 mrem to this intruder scenario based on the PA inventory. The inventory at closure for these radionuclides decreased substantially and the closure intruder dose is reduced to 30.2 mrem. The dose reduction in $^{137}Cs/^{137m}Ba$ is larger than the increase in dose due to ^{239}Pu. Therefore, the inventory at closure does not alter the finding in the PA that the projected intruder doses are less than the performance objectives.

3. UNCERTAINTY

The inventory estimates presented in the report contain uncertainties. The volume estimates for the solid and liquid fractions were based on visual inspection of tank videos and comparisons to objects on the tank floor (i.e., cooling coils and support structures) with know dimensions. Since direct measurements were not available for the depth of the liquid and solids, visual estimates from the video were always estimated toward the high end for all depth estimates.

4. CONCLUSIONS

The estimated inventory presented in this report is based upon conservative estimates of the depth of solid and liquid residual fractions remaining in the post-decontaminated tank. The Tank Farm PA (DOE-ID 2003) inventory was based on operational knowledge and initial estimates of the post-decontamination residual volumes. The post-decontamination residual solids and liquid volumes have been found to be significantly reduced from the estimates made in the PA.

The WM-183 inventory at closure is lower than the projected conservative inventory used in the Tank Farm PA (DOE-ID 2003) for all radionuclides of interest except for ^{239}Pu. However, as stated previously, ^{239}Pu is only important to the intruder analysis. The intruder doses are dominated by the gamma-emitting radionuclides, such as $^{137}Cs/^{137m}Ba$, which were determined to be significantly reduced in the inventory at closure. Therefore, the slight increase in the ^{239}Pu inventory does not increase the total intruder doses presented in the PA. In fact, the intruder

doses presented in the PA would be reduced based on the inventory at closure due to the decrease in the dominant $^{137}Cs/^{137m}Ba$ inventory.

The WM-183 inventory at closure is lower for all radionuclides which dominate the groundwater pathway doses. Therefore, the groundwater pathway doses presented in the PA would be reduced based on the inventory at closure for WM-183.

The results presented in this report provide strong evidence that the performance objectives presented in the PA would be met based upon the inventory at closure for WM-183.

5. REFERENCES

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Attachment 1

WM-183 Liquid Sample Laboratory Data

Table Att-1-1. WM-183 liquid sample laboratory results (all units in pCi/L).

Field Sample ID	Location	Analysis Type	Analyte[a]	Result	Result Used in UCL Calc.	Flag	MDA	Number of Detects	95% UCL or Highest Detection	Value Used in Inventory
CP10060201X3	WM-183 TR-53	RADS	^{241}Am	2.02E+05	2.02E+05		1.72E+03			
CP10060301X3	WM-183 TR-54	RADS	^{241}Am	1.87E+05	1.87E+05		2.32E+03			
CP10060401X3	WM-183 TR-53	RADS	^{241}Am	1.62E+05	1.62E+05		5.13E+02			
CP10060501X3	WM-183 TR-54	RADS	^{241}Am	1.80E+05	1.80E+05		5.09E+02			
CP10060101X3	WM-183 TR-13	RADS	^{241}Am	1.83E+05	1.83E+05		4.93E+02	5	1.97E+05	95% UCL
CP10060101X5	WM-183 TR-13	RADS	^{14}C	3.35E+00	6.90E+00	U	1.38E+01			
CP10060201X5	WM-183 TR-53	RADS	^{14}C	1.00E+01	1.00E+01	UJ	1.38E+01			
CP10060301X5	WM-183 TR-54	RADS	^{14}C	1.65E+01	1.65E+01		1.38E+01			
CP10060401X5	WM-183 TR-53	RADS	^{14}C	1.72E+01	1.72E+01		1.38E+01			
CP10060501X5	WM-183 TR-54	RADS	^{14}C	1.04E+01	1.04E+01	UJ	1.38E+01	2	1.72E+01	Highest Detect
CP10060201X3	WM-183 TR-53	RADS	^{244}Cm	4.61E+03	4.61E+03		2.89E+01			
CP10060301X3	WM-183 TR-54	RADS	^{244}Cm	4.56E+03	4.56E+03		2.30E+01			
CP10060401X3	WM-183 TR-53	RADS	^{244}Cm	2.90E+03	2.90E+03		1.92E+01			
CP10060501X3	WM-183 TR-54	RADS	^{244}Cm	3.92E+03	3.92E+03		2.66E+01			
CP10060101X3	WM-183 TR-13	RADS	^{244}Cm	3.06E+03	3.06E+03		2.93E+01	5	4.58E+03	95% UCL
CP10062201R4	WM-183 TR-53 (After Re-wash)	Gamma	^{60}Co	8.69E+03	8.69E+03		1.99E+03			
CP10062301R4	WM-183 TR-54 (After Re-wash)	Gamma	^{60}Co	5.47E+02	1.16E+03	U	2.31E+03			
CP10062401R4	WM-183 TR-13 (After Re-wash)	Gamma	^{60}Co	8.59E+02	1.17E+03	U	2.34E+03			
CP10062501R4	WM-183 TR-53 (After Re-wash)	Gamma	^{60}Co	2.82E+03	1.43E+03	U	2.85E+03			

Table Att-1-1. (continued).

Field Sample ID	Location	Analysis Type	Analyte[a]	Result	Result Used in UCL Calc.	Flag	MDA	Number of Detects	95% UCL or Highest Detection	Value Used in Inventory
CP10062601R4	WM-183 TR-54 (After Re-wash)	Gamma	^{60}Co	3.15E+00	1.25E+03	U	2.50E+03	1	8.69E+03	Highest Detect
CP10062201R4	WM-183 TR-53 (After Re-wash)	Gamma	^{137}Cs	1.11E+08	1.11E+08		1.15E+04			
CP10062301R4	WM-183 TR-54 (After Re-wash)	Gamma	^{137}Cs	5.74E+07	5.74E+07		9.55E+03			
CP10062401R4	WM-183 TR-13 (After Re-wash)	Gamma	^{137}Cs	4.73E+07	4.73E+07		8.91E+03			
CP10062501R4	WM-183 TR-53 (After Re-wash)	Gamma	^{137}Cs	1.00E+08	1.00E+08		1.32E+04			
CP10062601R4	WM-183 TR-54 (After Re-wash)	Gamma	^{137}Cs	6.38E+07	6.38E+07		1.03E+04	5	1.03E+08	95% UCL
CP10062201R4	WM-183 TR-53 (After Re-wash)	Gamma	^{154}Eu	1.29E+04	1.29E+04		1.00E+04			
CP10062301R4	WM-183 TR-54 (After Re-wash)	Gamma	^{154}Eu	5.80E+03	4.11E+03	U	8.21E+03			
CP10062401R4	WM-183 TR-13 (After Re-wash)	Gamma	^{154}Eu	5.73E+03	3.82E+03	U	7.63E+03			
CP10062501R4	WM-183 TR-53 (After Re-wash)	Gamma	^{154}Eu	1.05E+04	5.35E+03	U	1.07E+04			
CP10062601R4	WM-183 TR-54 (After Re-wash)	Gamma	^{154}Eu	5.83E+03	4.12E+03	U	8.24E+03	1	1.29E+04	Highest Detect
CP10060201X3	WM-183 TR-53	Gamma	^{155}Eu	6.48E+05	6.48E+05		9.79E+04			
CP10060301X3	WM-183 TR-54	Gamma	^{155}Eu	1.21E+05	6.10E+04	U	1.22E+05			
CP10060401X3	WM-183 TR-53	Gamma	^{155}Eu	4.19E+05	4.19E+05		6.60E+04			
CP10060501X3	WM-183 TR-54	Gamma	^{155}Eu	8.86E+04	4.48E+04	U	8.95E+04			

Table Att-1-1. (continued).

Field Sample ID	Location	Analysis Type	Analyte[a]	Result	Result Used in UCL Calc.	Flag	MDA	Number of Detects	95% UCL or Highest Detection	Value Used in Inventory
CP10060101X3	WM-183 TR-13	Gamma	^{155}Eu	3.80E+05	3.80E+05		6.03E+04	3	6.48E+05	Highest Detect
CP10060201X3	WM-183 TR-53	RADS	^{3}H	6.48E+05	6.48E+05		3.07E+03			
CP10060301X3	WM-183 TR-54	RADS	^{3}H	6.71E+05	6.71E+05		3.08E+03			
CP10060401X3	WM-183 TR-53	RADS	^{3}H	4.53E+05	4.53E+05		3.09E+03			
CP10060501X3	WM-183 TR-54	RADS	^{3}H	4.29E+05	4.29E+05		3.09E+03			
CP10060101X3	WM-183 TR-13	RADS	^{3}H	4.34E+05	4.34E+05		3.09E+03	5	6.43E+05	95% UCL
CP10060101X5	WM-183 TR-13	RADS	^{129}I	8.40E+02	8.40E+02	J	3.30E+02			
CP10060201X5	WM-183 TR-53	RADS	^{129}I	1.48E+03	1.48E+03	J	4.67E+01			
CP10060301X5	WM-183 TR-54	RADS	^{129}I	1.62E+03	1.62E+03	J	6.60E+01			
CP10060401X5	WM-183 TR-53	RADS	^{129}I	1.15E+03	1.15E+03	J	5.11E+01			
CP10060501X5	WM-183 TR-54	RADS	^{129}I	9.96E+02	9.96E+02	J	3.62E+01	5	1.53E+03	95% UCL
CP10062201R4	WM-183 TR-53 (After Re-wash)	Gamma	^{94}Nb	1.09E+04	1.09E+04		4.44E+03			
CP10062301R4	WM-183 TR-54 (After Re-wash)	Gamma	^{94}Nb	1.02E+03	1.31E+03	U	2.62E+03			
CP10062401R4	WM-183 TR-13 (After Re-wash)	Gamma	^{94}Nb	2.53E+02	1.42E+03	U	2.83E+03			
CP10062501R4	WM-183 TR-53 (After Re-wash)	Gamma	^{94}Nb	1.77E+00	2.32E+03	U	4.63E+03			
CP10062601R4	WM-183 TR-54 (After Re-wash)	Gamma	^{94}Nb	3.14E+03	1.71E+03	U	3.41E+03	1	1.09E+04	Highest Detect
CP10060101X4	WM-183 TR-13	RADS	^{63}Ni	2.25E+05	2.25E+05		5.13E+02			
CP10060201X4	WM-183 TR-53	RADS	^{63}Ni	3.29E+05	3.29E+05		5.17E+02			

Table Att-1-1. (continued).

Field Sample ID	Location	Analysis Type	Analyte[a]	Result	Result Used in UCL Calc.	Flag	MDA	Number of Detects	95% UCL or Highest Detection	Value Used in Inventory
CP10060301X4	WM-183 TR-54	RADS	^{63}Ni	2.84E+05	2.84E+05		4.77E+02			
CP10060401X4	WM-183 TR-53	RADS	^{63}Ni	2.12E+05	2.12E+05		4.77E+02			
CP10060501X4	WM-183 TR-54	RADS	^{63}Ni	2.20E+05	2.20E+05		5.10E+02	5	3.02E+05	95% UCL
CP10060201X3	WM-183 TR-53	RADS	^{237}Np	3.33E+03	3.33E+03		3.77E+02			
CP10060301X3	WM-183 TR-54	RADS	^{237}Np	2.89E+03	2.89E+03		3.05E+02			
CP10060401X3	WM-183 TR-53	RADS	^{237}Np	1.92E+03	1.92E+03		2.30E+02			
CP10060501X3	WM-183 TR-54	RADS	^{237}Np	2.63E+03	2.63E+03		1.83E+02			
CP10060101X3	WM-183 TR-13	RADS	^{237}Np	2.04E+03	2.04E+03		3.55E+02	5	3.12E+03	95% UCL
CP10060201X3	WM-183 TR-53	RADS	^{238}Pu	2.94E+05	2.94E+05		8.01E+01			
CP10060301X3	WM-183 TR-54	RADS	^{238}Pu	4.00E+05	4.00E+05		4.57E+01			
CP10060401X3	WM-183 TR-53	RADS	^{238}Pu	4.98E+05	4.98E+05		4.61E+01			
CP10060501X3	WM-183 TR-54	RADS	^{238}Pu	1.22E+06	1.22E+06		5.68E+01			
CP10060101X3	WM-183 TR-13	RADS	^{238}Pu	9.02E+05	9.02E+05		7.45E+01	5	1.03E+06	95% UCL
CP10060201X3	WM-183 TR-53	RADS	^{239}Pu	9.71E+04	9.71E+04		6.41E+01			
CP10060301X3	WM-183 TR-54	RADS	^{239}Pu	1.35E+05	1.35E+05		4.03E+01			
CP10060401X3	WM-183 TR-53	RADS	^{239}Pu	1.64E+05	1.64E+05		3.58E+01			
CP10060501X3	WM-183 TR-54	RADS	^{239}Pu	3.93E+05	3.93E+05		4.94E+01			
CP10060101X3	WM-183 TR-13	RADS	^{239}Pu	3.01E+05	3.01E+05		6.63E+01	5	3.37E+05	95% UCL
CP10060101X4	WM-183 TR-13	RADS	^{241}Pu	4.39E+04	4.39E+04	J	4.32E+04			
CP10060201X4	WM-183 TR-53	RADS	^{241}Pu	1.28E+05	1.28E+05	J	4.32E+04			
CP10060301X4	WM-183 TR-54	RADS	^{241}Pu	1.30E+05	1.30E+05	J	4.32E+04			
CP10060401X4	WM-183 TR-53	RADS	^{241}Pu	1.03E+05	1.03E+05	J	4.32E+04			
CP10060501X4	WM-183 TR-54	RADS	^{241}Pu	1.02E+05	1.02E+05	J	4.32E+04	5	1.35E+05	95% UCL

Table Att-1-1. (continued).

Field Sample ID	Location	Analysis Type	Analyte[a]	Result	Result Used in UCL Calc.	Flag	MDA	Number of Detects	95% UCL or Highest Detection	Value Used in Inventory
CP10062201R4	WM-183 TR-53 (After Re-wash)	Gamma	^{125}Sb	3.18E+05	3.18E+05		7.61E+04			
CP10062301R4	WM-183 TR-54 (After Re-wash)	Gamma	^{125}Sb	4.85E+04	2.45E+04	U	4.90E+04			
CP10062401R4	WM-183 TR-13 (After Re-wash)	Gamma	^{125}Sb	3.09E+04	2.12E+04	U	4.24E+04			
CP10062501R4	WM-183 TR-53 (After Re-wash)	Gamma	^{125}Sb	2.07E+05	2.07E+05		6.55E+04			
CP10062601R4	WM-183 TR-54 (After Re-wash)	Gamma	^{125}Sb	4.90E+04	2.48E+04	U	4.95E+04	2	3.18E+05	Highest Detect
CP10060101X4	WM-183 TR-13	RADS	Total-Sr	5.03E+08	5.03E+08	J	8.03E+06			
CP10060201X4	WM-183 TR-53	RADS	Total-Sr	7.28E+08	7.28E+08		5.11E+06			
CP10060301X4	WM-183 TR-54	RADS	Total-Sr	9.49E+08	9.49E+08		5.49E+06			
CP10060401X4	WM-183 TR-53	RADS	Total-Sr	7.64E+08	7.64E+08		5.65E+06			
CP10060501X4	WM-183 TR-54	RADS	Total-Sr	5.26E+08	5.26E+08		7.03E+06	5	8.70E+08	95% UCL
CP10062201EA	WM-183 TR-53 (After Re-wash)	ICP-MS	^{99}Tc	1.76E+03	1.76E+03	J				
CP10062401EA	WM-183 TR-13 (After Re-wash)	ICP-MS	^{99}Tc	4.99E+02	4.99E+02	J				
CP10062501EA	WM-183 TR-53 (After Re-wash)	ICP-MS	^{99}Tc	1.32E+03	1.32E+03	J				
CP10062601EA	WM-183 TR-54 (After Re-wash)	ICP-MS	^{99}Tc	8.04E+02	8.04E+02	J		4	1.75E+03	95% UCL
CP10060201X3	WM-183 TR-53	RADS	^{234}U	1.82E+03	1.82E+03		4.99E+01			
CP10060301X3	WM-183 TR-54	RADS	^{234}U	1.44E+03	1.44E+03		2.64E+01			

Table Att-1-1. (continued).

Field Sample ID	Location	Analysis Type	Analyte[a]	Result	Result Used in UCL Calc.	Flag	MDA	Number of Detects	95% UCL or Highest Detection	Value Used in Inventory
CP10060401X3	WM-183 TR-53	RADS	^{234}U	1.30E+03	1.30E+03		7.48E+01			
CP10060501X3	WM-183 TR-54	RADS	^{234}U	1.04E+03	1.04E+03		7.50E+01			
CP10060101X3	WM-183 TR-13	RADS	^{234}U	1.02E+03	1.02E+03		5.24E+01	5	1.64E+03	95% UCL
CP10060201X3	WM-183 TR-53	RADS	^{235}U	8.90E+01	8.90E+01	J	3.44E+01			
CP10060301X3	WM-183 TR-54	RADS	^{235}U	4.33E+01	4.33E+01	J	2.60E+01			
CP10060401X3	WM-183 TR-53	RADS	^{235}U	6.40E+01	6.40E+01	J	5.10E+01			
CP10060501X3	WM-183 TR-54	RADS	^{235}U	2.17E+01	2.92E+01	U	5.84E+01			
CP10060101X3	WM-183 TR-13	RADS	^{235}U	1.25E+02	1.25E+02	J	3.55E+01	4	1.06E+02	95% UCL
CP10060201X3	WM-183 TR-53	RADS	^{238}U	7.40E+01	7.40E+01	J	2.87E+01			
CP10060301X3	WM-183 TR-54	RADS	^{238}U	5.23E+01	5.23E+01	J	2.06E+01			
CP10060401X3	WM-183 TR-53	RADS	^{238}U	6.99E+01	6.99E+01	J	2.71E+01			
CP10060501X3	WM-183 TR-54	RADS	^{238}U	8.74E+01	1.90E+01	U	3.79E+01			
CP10060101X3	WM-183 TR-13	RADS	^{238}U	1.27E+01	1.56E+01	U	3.12E+01	3	7.40E+01	Highest Detect

a. Radionuclides with half-lives of less than two years were not considered (i.e., ^{108m}Ag, ^{144}Ce, ^{58}Co, ^{134}Cs, ^{54}Mn, ^{103}Ru, ^{106}Ru, ^{65}Zn, and ^{95}Zr. ^{226}Ra was also eliminated due to false-positive results from the laboratory due to methods used (i.e., gamma). Radionuclides with "U"-flagged results only were also eliminated.

Attachment 2

WM-183 Solid Sample Laboratory Data

Table Att-2-1. WM-183 solids sample laboratory results (all units in pCi/g).

Field Sample ID	Location	Lab Sample ID	Analysis Type	Analyte[a]	Result	Flag	MDA	Value Used in Inventory
CP10061901R4	WM-183	3AF53	Gamma	^{241}Am	3.40E+05		2.23E+05	√
CP10062801	WM-183	3BW46	Gamma	^{241}Am	6.19E+05	UJ	9.30E+05	
CP10061901R4	WM-183	3AF53	Gamma	^{60}Co	1.49E+05		1.31E+04	
CP10062801	WM-183	3BW46	Gamma	^{60}Co	1.87E+05	J	2.11E+04	√
CP10061901R4	WM-183	3AF53	Gamma	^{137}Cs	1.19E+09		1.20E+05	√
CP10062801	WM-183	3BW46	Gamma	^{137}Cs	1.16E+09	J	1.92E+05	
CP10061901R4	WM-183	3AF53	Gamma	^{94}Nb	2.55E+04	U	3.66E+04	
CP10062801	WM-183	3BW46	Gamma	^{94}Nb	1.66E+05	J	6.44E+04	√
CP10062801	WM-183	3BW46	RADS	^{238}Pu	9.99E+06	J	1.79E+03	√
CP10062801	WM-183	3BW46	RADS	^{239}Pu	2.75E+06	J	1.47E+03	√
CP10061901R4	WM-183	3AF53	Gamma	^{125}Sb	2.77E+06		2.65E+05	
CP10062801	WM-183	3BW46	Gamma	^{125}Sb	6.78E+06	J	1.19E+06	√
CP10061901F2	WM-183	2AF53	RADS	^{90}Sr	2.39E+07		3.23E+05	√
CP10062801	WM-183	3BW46	RADS	^{90}Sr	1.67E+07	J	3.18E+05	
CP10062801	WM-183	3BW46	RADS	^{234}U	2.98E+03	J	4.75E+02	√
CP10061901EA	WM-183	3BM72	ICP-MS	^{99}Tc	6.17E+05	H, J		√
CP10062801EA	WM-183	4CN11	ICP-MS	^{99}Tc	4.25E+05	H, J		
CP10061901RI	WM-183	02KU01A	Specific	^{129}I	6.24E+02	J	1.15E+02	√
CP10062801RI	WM-183	02KU03A	Specific	^{129}I	4.96E+02	J	1.08E+02	

a. Radionuclides with half-lives of less than two years were not considered (i.e., ^{108m}Ag, ^{144}Ce, ^{58}Co, ^{134}Cs, ^{54}Mn, ^{103}Ru, ^{106}Ru, ^{65}Zn, and ^{95}Zr. ^{235}U and ^{226}Ra were also eliminated due to false-positive results from the laboratory due to methods used (i.e., gamma). ^{152}Eu and ^{155}Eu were not considered since all results were negative. ^{154}Eu results were an order of magnitude below the predicted ORIGEN2 value, for conservativeness the ORIGEN2 value was used in place of the laboratory results.