Appendix E

Calcine Filter Data and Related Disposals

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Appendix E

Calcine Filter Data and Related Disposals

E-1. BACKGROUND

This appendix provides supplemental calculations for fission products, transuranic waste, and bulk actinide contaminants sent to the Subsurface Disposal Area (SDA) during the Historical Data Task (HDT) (LMITCO 1995) period (i.e., 1952 through 1983). This appendix addresses major waste streams that contained these contaminants. Data in this appendix are intended to augment inventory developments presented in Section 3 of the main body of this report and to be used in conjunction with Appendix C. Best-estimate isotopic profiles are developed for major waste streams that contain irradiated fuel-based contaminants and bulk actinide shipments. Estimates presented in this appendix are subject to extensive revision after review by Argonne National Laboratory-West personnel. Because of gaps in existing shipping records for the HDT period, conservative assumptions were used to estimate final fission-product and actinide disposals during the HDT period.

E-2. WASTE CALCINING FACILITY FILTER INVENTORY ANALYSIS

The purpose of this appendix is to supplement the information that was discussed in Section 3.8 of the main body of this report concerning the Waste Calcining Facility (WCF) and related filter disposals sent to the Radioactive Waste Management Complex (RWMC) (i.e., the SDA). This waste stream consisted of significant amounts of fission product contaminants, actinides, and trace amounts of activation products. The dates of these filter disposals were determined by Wenzel (2000a) and are summarized in Table E-1. In general, the composition of the waste disposals was variable and depended on the specific reprocessing campaign and the calcine material that was involved. In addition, the amount of activity and the radionuclide distribution contained within the WCF calcine varied, depending on the type of waste, the age of this material, and the concentration of radionuclides in the particular tank being processed. Wenzel modeled several types of calcine wastes in his analysis. For example, wastes from the processing of aluminum fuels, zirconium fuels, the coprocessing of aluminum and zirconium fuels, and stainless steel materials were considered. However, not all of the disposal data that were used by Wenzel were obtained from shipping records. Some data were obtained from the Chemical Processing Plant (CPP) (e.g., the Idaho Nuclear Technology and Engineering Center [INTEC]) production monthly reports, and this information was ultimately used to quantify the early WCF disposals that were not always explicitly reported on the 110 shipping forms.[a]

A review of the Radioactive Waste Management Information System (RWMIS) data indicates that the reported isotopic distributions that are frequently shown in the RWMIS database are inaccurate. Reported gross activities may be reasonable, but the isotopic breakdowns are incorrect. Also, many of the contaminants of interest were not reported. Therefore, in the current analysis, the filter activity data from the RWMIS and WasteOScope databases were replaced with more detailed information from Wenzel's best-estimate analysis.[b]

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a. Information on the early WCF filter shipments (i.e., before 1971) was determined by Dan Staiger from CPP production reports. These data were then given to Doug Wenzel for his analysis.

b. As mentioned in Wenzel (2000a), "during the operation of the Waste Calcining Facility (WCF) between 1964 and 1981, filter assemblies from the off-gas system were routinely shipped to the RWMC" for disposal. "The shipping forms prepared at the time of shipment did not contain all of the radionuclides actually present. In addition, most of the activities of the radionuclides reported were at best rough estimates."

In order to determine the activities of some radionuclides that must have been present, but were not reported in the shipping records or in some portions of Wenzel's analysis, a set of scaling factors were calculated and referenced to the Cs-137 activity. These scaling factors are shown in Table E-2. The rationale for these numbers is discussed below. Not all of the Waste Area Group 7 requested radionuclides were reported by Wenzel (e.g., see Table 2 of Wenzel [2000a]). Notable exceptions include: Cl-36, Ni-59, Pb-210, Ac-227, the thorium isotopes, Pa-231, and the curium isotopes. In addition, most of the data reported by Wenzel were decayed to the year 2000, or beyond. Consequently, reverse-decay calculations were necessary in order to determine the filter activity at the time of each disposal. Also, the inventory associated with the missing radionuclides had to be determined. Except for Cl-36, all missing radionuclide data were eventually calculated from scaling factors that were estimated from a larger set of ORIGEN2 calculations, including calculations originally performed for only one type of calcine material (see Attachment O from Wenzel [2000a]). The best-estimate scaling factor data are shown in Table E-2. These data were determined from two possible methods. Method 1 corrected the 2000 inventory data shown in Table 2 of Wenzel [September 2000] to the year 1986; then, the activity of each radionuclide was divided by the calculated Cs-137 activity. The Method 1 results are shown in Table E-2. To determine the activity of those radionuclides not included in the Method 1 analysis, a second set of scaling factors were determined from the data shown in Attachment O of Wenzel (2000a). Since the alternate dataset (i.e., Method 2) only considered one type of calcine material, the Method 2 results are considered to be less accurate than the Method 1 results; however, the Method 2 data (also decay corrected to 1986) are useful because they includes many radionuclides not previously considered by the Method 1 analysis. The only radionuclide not considered in either method was Cl-36. In the case of Cl-36 no scaling factor data were possible due to a lack of any inventory data for this radionuclide in the calcine material. Nevertheless, the Cl-36 inventory in INTEC calcine material is believed to be negligible; at least when compared against the Cl-36 inventory in activated metal.

The best-estimate scaling factors were then determined from a combination of the two alternative methods. Method 1, representing the more reliable data, was accepted as the best estimate values whenever possible. However, when no data from Method 1 was available, then the Method 2 values were accepted. All of these data are shown in Table E-2. In any case, a simple comparison of the two sets of scaling factors in Table E-2 shows that the Method 1 and Method 2 values are reasonably consistent.

Table E-3 shows the WCF filter inventory data that was obtained from Attachment U of Wenzel (2000a)[c]. The data are summarized by shipping year, but are decay corrected to the year 2000. For example, the tritium (H-3) activity contained within the twelve WCF filters shipped to RWMC in 1964 is shown in Table E-3 as 2.61E-1 Ci; however, this value has been decay corrected to the year 2000. To determine the tritium activity in these filters computed for the year 1964, the 2000-year data were reverse decay-corrected 36 years to the year 1964. A simple reverse decay calculation indicates that the corresponding 1964 inventory of H-3 was 1.97 Ci. That is, $0.260\ \text{Ci} = 1.97 \times \exp(-36\text{y} \times \ln(2)/12.33\text{y})$. By mathematically correcting the Table E-3 data back to the year of shipment, the WCF filter inventories were calculated for the time of each filter disposal. These results are shown in Table E-4. Note that the reverse-decay calculations are simple for those radionuclides not strongly linked to precursor nuclides (e.g., in parent-daughter relationships). Although the parent-daughter corrections are mathematically more complex, these calculations were performed for several actinides (as indicated in Table E-4). In any case, it was later determined that the detailed parent-daughter calculations produced results not much different from simple reverse-decay calculations because of the long half-lives of most actinides. Finally, there were a few radionuclides that could not be directly computed because no data were reported by Wenzel

c. Filters from the New Waste Calciner Facility were not sent to the SDA. These filters were stored in a specially designed silo facility. Consequently, there were no calciner filter disposals in the Recent and Projected Data Task time frame.

(see Table E-3) for the year 2000. For these radionuclides, scaling factor calculations were performed based on the best-estimate Cs-137 inventory and the best-estimate scaling factor data shown in Column 3 of Table E-4. For example, to determine the Ni-59 inventory for 1964, the Ni-59 scaling factor and the Cs-137 activity for 1964 were used as follows: Ni-59 activity = 1.80E-3 Ci = 3.343E-6 × 5.38E+2. The results of these calculations are considered to be best-estimate values, and are shown in Table E-4. Upper-bound and lower-bound estimates were also made, and these results are shown in Tables E-5 and E-6, respectively. The upper-bound (or lower-bound) estimates were computed by multiplying, or dividing, the best estimate values by a factor of three.

Finally, the cumulative best-estimate activity data for the disposed WCF filters (computed at the time of each disposal) are summarized in Table E-7. Note that the data are also mentioned in Section 3.8. To verify that the back-calculated activities were correctly computed, the individual values were decay corrected to the year 2000 and then added together. These results, shown in Column 4 of Table E-7, are displayed next to Wenzel's original data for the year 2000. A simple comparison of both sets of data in Table E-7 (that is, Columns 4 and 5) indicates that the derived results are consistent with the original information reported by Wenzel (2000a).

E-3. CONTAINER DESCRIPTIONS FOR FILTER SHIPMENTS

A review of the container codes listed in the RWMIS database for filter disposals made to RWMC from INTEC indicates that most shipments were made in four possible container configurations: (1) "O" for other (e.g., an unknown container), (2) "BXC" for a cardboard box, (3) "BXW" indicating a wooden box, or (4) "I" for insert. Any or all of these containers would have been shipped to RWMC inside a shielded cask (e.g., the WCF cask) and probably within a cask liner. The cask liner may have been disposed with the INTEC waste. However, the most typical cask liner consisted of a metal structure open at the top; therefore, the waste would have been in close contact with the soil and little or no credit should be assumed for the waste package.

Table E-1. Waste Calcining Facility HEPA filter shipping data obtained from Attachment R of Wenzel (2000a). Note: Al=Aluminum, C=Coprocessed waste, S=stainless steel, and Zr=Zirconium.

WCF Filter Sequence Numbers	Shipping Year	WM Tanks Involved	Calcine Types Considered
1 – 12	1964	185, 187, 183, 180	Al
None	1965	—	—
13 – 17	1966	183, 182, 180	Al
18 – 32	1967	180, 182,	Al
33 – 36	1968	188	Zr
37 – 44	1969	188, 189, 185	Zr, Al
45	1970	189	Zr
46 – 53	1971	187	Zr
54 – 60	1972	189, 183	Zr, Al
61 – 68	1973	188, 189	Zr
69 – 80	1974	183, 187, 189	Al, Zr
81 – 87	1975	187	Zr
88 – 93	1976	185	C
94 – 101	1977	185	C
102 – 136	1978	182+0	C, S
137 – 152	1979	182, 188+0, 182+0	C, S
153 – 166	1980	189+0, 185	Zr
167 – 183	1981	189	Zr

Table E-2. Scaling factors (relative to Cs-137) for radionuclides in INTEC calcine wastes based on ORIGEN2 data reported in Wenzel (2000a), but decay-corrected to 1986.

Nuclide	Method 1 Scaling Factors Cs-137 (ratio)	Method 2 Scaling Factors Cs-137 (ratio)	Best-estimate Scaling Factors Relative to Cs-137 (ratio)
H-3	2.85E-03	2.11E-03	2.85E-03
Be-10	3.81E-11	4.58E-11	3.81E-11
C-14	1.60E-09	1.85E-09	1.60E-09
Cl-36	No data	No data	No data
Co-60	1.25E-03	2.98E-04	1.25E-03
Ni-59	No data	3.34E-06	3.34E-06
Ni-63	2.27E-04	4.50E-04	2.27E-04
Sr-90	1.01E+00	9.37E-01	1.01E+00
Nb-94	3.09E-10	3.42E-10	3.09E-10
Tc-99	1.98E-04	2.17E-04	1.98E-04
I-129	3.20E-07	3.57E-07	3.20E-07
Cs-137	**1.00E+00**	**1.00E+00**	**1.00E+00**
Eu-152	7.10E-05	7.33E-05	7.10E-05
Eu-154	1.30E-02	6.42E-03	1.30E-02
Pb-210	No data	2.60E-12	2.60E-12
Ra-226	3.68E-10	9.05E-12	3.68E-10
Ra-228	5.56E-14	1.66E-15	5.56E-14
Ac-227	No data	9.56E-11	9.56E-11
Th-228	No data	1.72E-05	1.72E-05
Th-229	No data	7.90E-13	7.90E-13
Th-230	No data	1.38E-09	1.38E-09
Th-232	No data	2.59E-15	2.59E-15
Pa-231	No data	2.52E-10	2.52E-10
U-232	3.47E-08	5.20E-08	3.47E-08
U-233	4.96E-11	9.90E-12	4.96E-11
U-234	3.51E-06	5.98E-06	3.51E-06
U-235	2.29E-08	3.79E-08	2.29E-08
U-236	5.72E-08	9.98E-08	5.72E-08
U-238	1.18E-09	1.87E-09	1.18E-09
Np-237	3.43E-07	1.29E-08	3.43E-07

Table E-2. (continued).

Nuclide	Method 1 Scaling Factors Cs-137 (ratio)	Method 2 Scaling Factors Cs-137 (ratio)	Best-estimate Scaling Factors Relative to Cs-137 (ratio)
Pu-238	4.17E-03	7.83E-03	4.17E-03
Pu-239	6.86E-05	1.21E-04	6.86E-05
Pu-240	5.34E-05	1.09E-04	5.34E-05
Pu-241	6.07E-03	4.22E-03	6.07E-03
Pu-242	1.11E-07	2.58E-07	1.11E-07
Pu-244	1.68E-15	6.39E-15	1.68E-15
Am-241	2.96E-04	2.30E-04	2.96E-04
Am-243	No data	2.80E-06	2.80E-06
Cm-243	No data	8.86E-08	8.86E-08
Cm-244	No data	5.45E-06	5.45E-06
Cm-245	No data	4.93E-10	4.93E-10
Cm-246	No data	3.91E-11	3.91E-11
Cm-247	No data	5.05E-17	5.05E-17
Cm-248	No data	6.13E-17	6.13E-17

Table E-3. Best-estimate inventory (Ci) for 183 Waste Calcining Facility filters shipped to RWMC based on Wenzel's data (results are decay corrected to the year 2000).[a]

Best Estimate Nuclide	Shipping date = Values reported on = Shipping sequence = Half-life (y)	1964 2000 1 – 12 (Ci)	1965 2000 none (Ci)	1966 2000 13 – 17 (Ci)	1967 2000 18 – 32 (Ci)	1968 2000 33 – 36 (Ci)	1969 2000 37 – 44 (Ci)	1970 2000 45 (Ci)	1971 2000 46 – 53 (Ci)	1972 2000 54 – 60 (Ci)	1973 2000 61 – 68 (Ci)	1974 2000 69 – 80 (Ci)	1975 2000 81 – 87 (Ci)	1976 2000 88 – 93 (Ci)	1977 2000 94 – 101 (Ci)	1978 2000 102 – 136 (Ci)	1979 2000 137 – 152 (Ci)	1980 2000 153 – 166 (Ci)	1981 2000 167 – 183 (Ci)	Total (Ci)	Wenzel's Data for 2000 (Ci)
H-3	1.233E+01	2.61E-01	0.00E+00	7.60E-02	2.60E-01	3.40E-02	1.22E-01	5.10E-03	8.80E-02	1.43E-01	1.40E-01	1.90E-01	1.26E-01	1.08E-01	1.46E-01	7.13E-01	3.03E-01	3.40E-01	3.22E-01	3.377E+00	3.383E+00
Be-10	1.151E+06	1.65E-08	0.00E+00	4.38E-09	1.32E-08	6.00E-10	4.36E-09	8.10E-11	1.28E-09	2.61E-09	1.85E-09	4.21E-09	1.54E-09	3.96E-09	4.98E-09	2.71E-08	1.10E-08	4.44E-09	2.74E-09	1.047E-07	1.049E-07
C-14	5.730E+03	6.61E-07	0.00E+00	1.74E-07	5.42E-07	2.44E-08	1.75E-07	3.30E-09	5.28E-08	1.03E-07	7.43E-08	1.69E-07	6.23E-08	1.62E-07	1.98E-07	1.08E-06	4.38E-07	1.81E-07	1.13E-07	4.216E-06	4.225E-06
Cl-36	3.010E+05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Co-60	5.271E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	6.00E-03	8.58E-03	1.00E-03	1.84E-02	2.76E-02	3.41E-02	3.10E-02	3.71E-02	7.80E-03	1.14E-02	4.26E-02	1.79E-02	1.25E-01	1.50E-01	5.185E-01	5.192E-01
Ni-59	7.600E+04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ni-63	1.001E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.20E-03	1.22E-02	1.30E-03	2.08E-02	2.70E-02	2.96E-02	2.33E-02	2.52E-02	3.66E-02	4.60E-02	1.51E-01	5.63E-02	5.12E-02	4.76E-02	5.376E-01	5.360E-01
Sr-90	2.878E+01	2.18E+02	0.00E+00	6.00E+01	1.93E+02	1.88E+01	7.84E+01	2.60E+00	4.32E+01	7.26E+01	6.45E+01	9.82E+01	5.60E+01	6.60E+01	8.20E+01	4.27E+02	1.83E+02	1.40E+02	1.18E+02	1.922E+03	1.923E+03
Nb-94	2.030E+04	1.29E-07	0.00E+00	3.38E-08	1.05E-07	4.80E-09	3.40E-08	6.20E-10	9.60E-09	1.98E-08	1.40E-08	3.26E-08	1.19E-08	2.94E-08	3.68E-08	2.05E-07	8.36E-08	3.44E-08	2.13E-08	8.052E-07	8.051E-07
Tc-99	2.111E+05	8.20E-02	0.00E+00	2.14E-02	6.76E-02	3.00E-03	2.16E-02	4.00E-04	6.48E-03	1.30E-02	9.00E-03	2.08E-02	7.70E-03	1.86E-02	2.36E-02	1.31E-01	5.34E-02	2.21E-02	1.38E-02	5.149E-01	5.149E-01
I-129	1.570E+07	1.31E-04	0.00E+00	3.50E-05	1.09E-04	4.80E-06	3.41E-05	6.60E-07	1.04E-05	2.13E-05	1.48E-05	3.38E-05	1.26E-05	3.12E-05	3.86E-05	2.14E-04	8.65E-05	3.59E-05	2.26E-05	8.368E-04	8.395E-04
Cs-137	3.007E+01	2.35E+02	0.00E+00	6.40E+01	2.08E+02	1.44E+01	7.48E+01	2.00E+00	3.28E+01	5.98E+01	4.97E+01	8.90E+01	4.27E+01	7.20E+01	9.00E+01	4.61E+02	1.95E+02	1.15E+02	8.97E+01	1.895E+03	1.892E+03
Eu-152	1.354E+01	3.21E-03	0.00E+00	9.30E-04	3.12E-03	1.16E-03	2.42E-03	1.70E-04	2.88E-03	4.23E-03	4.60E-03	4.69E-03	4.20E-03	4.02E-03	5.24E-03	2.05E-02	8.24E-03	1.05E-02	1.03E-02	9.050E-02	9.055E-02
Eu-154	8.593E+00	2.87E-01	0.00E+00	8.80E-02	2.97E-01	1.60E-01	3.12E-01	2.50E-02	4.32E-01	6.31E-01	7.27E-01	7.24E-01	7.00E-01	2.70E-01	3.62E-01	1.54E+00	6.53E-01	1.93E+00	2.11E+00	1.125E+01	1.127E+01
Pb-210	2.230E+01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ra-226	1.600E+03	2.66E-07	0.00E+00	6.90E-08	2.23E-07	2.08E-10	5.82E-08	2.40E-11	3.68E-10	1.54E-08	4.52E-10	4.48E-08	3.22E-10	1.14E-09	1.32E-09	1.83E-07	8.30E-08	2.08E-08	3.39E-10	9.677E-07	9.639E-07
Ra-228	5.750E+00	4.22E-12	0.00E+00	1.40E-12	4.90E-12	4.40E-14	1.72E-12	7.40E-15	1.36E-13	8.12E-13	2.38E-13	2.56E-12	2.52E-13	2.16E-13	2.70E-13	5.35E-12	2.64E-12	1.49E-12	9.28E-13	2.718E-11	2.727E-11
Ac-227	2.180E+01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Th-228	1.910E+00	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Th-229	7.300E+03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Th-230	7.540E+04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Th-232	1.400E+10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Pa-231	3.280E+04	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
U-232	6.890E+01	3.57E-08	0.00E+00	9.60E-09	2.97E-08	8.00E-09	1.82E-08	1.10E-09	1.76E-08	2.56E-08	2.59E-08	2.70E-08	2.17E-08	9.60E-06	1.22E-05	3.91E-05	1.46E-05	1.24E-06	4.21E-08	7.700E-05	7.829E-05
U-233	1.592E+05	3.57E-08	0.00E+00	8.80E-09	2.60E-08	5.20E-10	7.21E-09	6.30E-11	9.60E-10	2.86E-09	1.32E-09	5.26E-09	9.80E-10	1.02E-09	1.22E-09	2.50E-08	1.07E-08	3.82E-09	1.39E-09	1.328E-07	1.329E-07
U-234	2.455E+05	6.66E-04	0.00E+00	1.74E-04	5.42E-04	1.08E-04	2.82E-04	1.50E-05	2.32E-04	3.37E-04	3.28E-04	3.67E-04	2.66E-04	5.34E-04	6.70E-04	2.60E-03	1.00E-03	5.83E-04	4.76E-04	9.176E-03	9.186E-03
U-235	7.038E+08	4.58E-06	0.00E+00	1.20E-06	3.79E-06	7.20E-07	1.92E-06	9.80E-08	1.60E-06	2.30E-06	2.22E-06	2.49E-06	1.82E-06	3.30E-06	4.10E-06	1.63E-05	6.31E-06	4.07E-06	3.39E-06	6.025E-05	6.021E-05
U-236	2.342E+07	1.05E-05	0.00E+00	2.82E-06	8.69E-06	1.92E-06	4.84E-06	2.60E-07	4.08E-06	5.94E-06	5.84E-06	6.39E-06	4.83E-06	8.40E-06	1.06E-05	4.27E-05	1.59E-05	1.05E-05	8.80E-06	1.530E-04	1.532E-04
U-238	4.470E+09	2.61E-07	0.00E+00	6.90E-08	2.15E-07	3.60E-08	1.02E-07	4.80E-09	7.68E-08	1.17E-07	1.11E-07	1.31E-07	9.10E-08	1.62E-07	2.04E-07	8.29E-07	3.19E-07	1.99E-07	1.64E-07	3.090E-06	3.090E-06
Np-237	2.144E+06	2.24E-04	0.00E+00	5.98E-05	1.86E-04	3.60E-06	5.26E-05	4.80E-07	7.60E-06	2.32E-05	1.11E-05	4.62E-05	9.10E-06	1.20E-06	1.46E-06	1.55E-04	6.99E-05	3.31E-05	1.62E-05	9.000E-04	8.984E-04
Pu-238	8.770E+01	9.58E-02	0.00E+00	2.58E-02	8.02E-02	1.68E-01	2.36E-01	2.30E-02	3.68E-01	4.92E-01	5.34E-01	4.46E-01	4.48E-01	6.60E-01	8.02E-01	2.65E+00	9.96E-01	9.24E-01	8.56E-01	9.809E+00	9.791E+00
Pu-239	2.411E+04	1.11E-02	0.00E+00	2.82E-03	8.84E-03	2.32E-03	5.34E-03	3.10E-04	4.96E-03	7.21E-03	7.11E-03	7.40E-03	5.88E-03	1.02E-02	1.30E-02	5.04E-02	1.94E-02	1.26E-02	1.07E-02	1.796E-01	1.784E-01
Pu-240	6.563E+03	4.31E-03	0.00E+00	1.13E-03	3.49E-03	2.16E-03	3.68E-03	2.90E-04	4.56E-03	6.24E-03	6.58E-03	5.85E-03	5.39E-03	9.60E-03	1.16E-02	4.10E-02	1.58E-02	1.12E-02	9.93E-03	1.429E-01	1.425E-01
Pu-241	1.435E+01	8.58E-02	0.00E+00	2.50E-02	8.17E-02	1.60E-01	2.36E-01	2.30E-02	3.92E-01	5.47E-01	6.21E-01	5.34E-01	5.60E-01	2.34E-01	3.10E-01	1.13E+00	4.44E-01	1.28E+00	1.38E+00	8.042E+00	8.073E+00
Pu-242	3.733E+05	3.26E-07	0.00E+00	8.60E-08	2.60E-07	4.80E-06	6.15E-06	6.40E-07	1.04E-05	1.32E-05	1.48E-05	1.16E-05	1.19E-05	2.22E-05	2.78E-05	8.96E-05	3.33E-05	2.36E-05	2.16E-05	2.922E-04	2.943E-04
Pu-244	8.080E+07	9.61E-15	0.00E+00	2.55E-15	7.95E-15	8.40E-19	2.20E-15	1.10E-19	1.76E-18	5.52E-16	2.51E-18	1.60E-15	2.10E-18	5.52E-13	6.88E-13	2.25E-12	8.30E-13	6.85E-14	3.80E-18	4.409E-12	4.406E-12
Am-241	4.322E+02	2.35E-02	0.00E+00	6.06E-03	1.93E-02	2.12E-02	3.14E-02	2.80E-03	4.32E-02	5.71E-02	6.08E-02	5.07E-02	4.83E-02	2.76E-02	3.36E-02	1.24E-01	4.66E-02	8.24E-02	7.74E-02	7.562E-01	7.556E-01
Am-243	7.370E+03	8.58E-08	0.00E+00	2.25E-08	6.98E-08	2.80E-10	1.90E-08	3.70E-11	6.00E-10	5.58E-09	8.79E-10	1.52E-08	7.00E-10	2.40E-04	3.02E-04	9.75E-04	3.63E-04	3.00E-05	1.27E-09	1.910E-03	1.916E-03
Cm-243	2.910E+01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cm-244	1.810E+01	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cm-245	8.500E+03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cm-246	4.760E+03	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cm-247	1.560E+07	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Cm-248	3.480E+05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Total =		4.54E+02	0.00E+00	1.24E+02	4.02E+02	3.38E+01	1.54E+02	4.68E+00	7.74E+01	1.34E+02	1.16E+02	1.89E+02	1.01E+02	1.39E+02	1.74E+02	8.94E+02	3.81E+02	2.60E+02	2.12E+02	3.85E+03	3.85E+03

a. Table values were computed from information shown in Attachments R, T, and U of Wenzel (2000a).
b. Obtained from Attachment T of Wenzel (2000a).

Table E-4. Best-estimate inventory (Ci) for the 183 Waste Calcining Facility filters shipped from INTEC to RWMC (results are based on Wenzel's data and are shown for the year of shipment).[a]

Best Estimate		Scaling Factors	Shipping date =	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1978	1980	1981	
		Relative to	Table values on =	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1978	1980	1981	
			Shipping sequence =	1 – 12	none	13 – 17	18 – 32	33 – 36	37 – 44	45	46 – 53	54 – 60	61 – 68	69 – 80	81 – 87	88 – 93	94 – 101	102 – 136	137 – 152	153 – 166	167 – 183	Total
Nuclide	Half-life (y)	Cs137	Analysis method[b]	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)
H-3	1.233E+01	2.847E-03	Reverse decay	1.97E+00	0.00E+00	5.14E-01	1.66E+00	2.05E-01	6.95E-01	2.75E-02	4.49E-01	6.90E-01	6.39E-01	8.19E-01	5.14E-01	4.16E-01	5.32E-01	2.46E+00	9.87E-01	1.05E+00	9.37E-01	1.456E+01
Be-10	1.151E+06	3.812E-11	Reverse decay	1.65E-08	0.00E+00	4.38E-09	1.32E-08	6.00E-10	4.36E-09	8.10E-11	1.28E-09	2.61E-09	1.85E-09	4.21E-09	1.54E-09	3.96E-09	4.98E-09	2.71E-08	1.10E-08	4.44E-09	2.74E-09	1.047E-07
C-14	5.730E+03	1.604E-09	Reverse decay	6.64E-07	0.00E+00	1.75E-07	5.44E-07	2.45E-08	1.76E-07	3.31E-09	5.30E-08	1.03E-07	7.45E-08	1.70E-07	6.25E-08	1.62E-07	1.99E-07	1.08E-06	4.40E-07	1.81E-07	1.13E-07	4.229E-06
Cl-36	3.010E+05	No data	NONE	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Co-60	5.271E+00	1.249E-03	Reverse decay	0.00E+00	0.00E+00	0.00E+00	0.00E+00	4.03E-01	5.06E-01	5.17E-02	8.34E-01	1.10E+00	1.19E+00	9.47E-01	9.93E-01	1.83E-01	2.35E-01	7.69E-01	2.83E-01	1.73E+00	1.82E+00	1.105E+01
Ni-59	7.600E+04	3.343E-06	Scaling factor	1.80E-03	0.00E+00	4.69E-04	1.49E-03	1.01E-04	5.11E-04	1.34E-05	2.14E-04	3.81E-04	3.10E-04	5.42E-04	2.54E-04	4.19E-04	5.11E-04	2.56E-03	1.06E-03	6.10E-04	4.65E-04	1.170E-02
Ni-63	1.001E+02	2.268E-04	Reverse decay	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.15E-02	1.51E-02	1.60E-03	2.54E-02	3.28E-02	3.57E-02	2.79E-02	3.00E-02	4.32E-02	5.39E-02	1.76E-01	6.51E-02	5.88E-02	5.43E-02	6.315E-01
Sr-90	2.878E+01	1.015E+00	Reverse decay	5.19E+02	0.00E+00	1.36E+02	4.27E+02	4.06E+01	1.65E+02	5.36E+00	8.69E+01	1.42E+02	1.24E+02	1.84E+02	1.02E+02	1.18E+02	1.43E+02	7.25E+02	3.04E+02	2.27E+02	1.86E+02	3.635E+03
Nb-94	2.030E+04	3.089E-10	Reverse decay	1.30E-07	0.00E+00	3.38E-08	1.05E-07	4.81E-09	3.41E-08	6.21E-10	9.61E-09	1.98E-08	1.40E-08	3.26E-08	1.19E-08	2.94E-08	3.68E-08	2.05E-07	8.36E-08	3.44E-08	2.13E-08	8.060E-07
Tc-99	2.111E+05	1.982E-04	Reverse decay	8.20E-02	0.00E+00	2.14E-02	6.76E-02	3.00E-03	2.16E-02	4.00E-04	6.48E-03	1.30E-02	9.00E-03	2.08E-02	7.70E-03	1.86E-02	2.36E-02	1.31E-01	5.34E-02	2.21E-02	1.38E-02	5.150E-01
I-129	1.570E+07	3.202E-07	Reverse decay	1.31E-04	0.00E+00	3.50E-05	1.09E-04	4.80E-06	3.41E-05	6.60E-07	1.04E-05	2.13E-05	1.48E-05	3.38E-05	1.26E-05	3.12E-05	3.86E-05	2.14E-04	8.65E-05	3.59E-05	2.26E-05	8.368E-04
Cs-137	3.007E+01	**1.000E+00**	Reverse decay	5.38E+02	0.00E+00	1.40E+02	4.45E+02	3.01E+01	1.53E+02	3.99E+00	6.40E+01	1.14E+02	9.26E+01	1.62E+02	7.60E+01	1.25E+02	1.53E+02	7.65E+02	3.17E+02	1.82E+02	1.39E+02	3.501E+03
Eu-152	1.354E+01	7.102E-05	Reverse decay	2.03E-02	0.00E+00	5.30E-03	1.69E-02	5.97E-03	1.18E-02	7.90E-04	1.27E-02	1.77E-02	1.83E-02	1.78E-02	1.51E-02	1.37E-02	1.70E-02	6.33E-02	2.41E-02	2.93E-02	2.73E-02	3.175E-01
Eu-154	8.593E+00	1.297E-02	Reverse decay	5.24E+00	0.00E+00	1.37E+00	4.25E+00	2.11E+00	3.80E+00	2.81E-01	4.48E+00	6.04E+00	6.42E+00	5.90E+00	5.26E+00	1.87E+00	2.31E+00	9.08E+00	3.55E+00	9.67E+00	9.77E+00	8.141E+01
Pb-210	2.230E+01	2.604E-12	Scaling factor	1.40E-09	0.00E+00	3.65E-10	1.16E-09	7.84E-11	3.98E-10	1.04E-11	1.67E-10	2.97E-10	2.41E-10	4.22E-10	1.98E-10	3.26E-10	3.98E-10	1.99E-09	8.25E-10	4.75E-10	3.62E-10	9.115E-09
Ra-226	1.600E+03	3.681E-10	Parent-daughter	2.70E-07	0.00E+00	7.00E-08	2.26E-07	2.11E-10	5.90E-08	2.43E-11	3.73E-10	1.56E-08	4.57E-10	4.53E-08	3.25E-10	1.15E-09	1.33E-09	1.85E-07	8.38E-08	2.10E-08	3.42E-10	9.803E-07
Ra-228	5.750E+00	5.564E-14	Parent-daughter	3.24E-10	0.00E+00	8.44E-11	2.62E-10	2.08E-12	7.22E-11	2.75E-13	4.49E-12	2.37E-11	6.17E-12	5.89E-11	5.13E-12	3.90E-12	4.32E-12	7.59E-11	3.32E-11	1.66E-11	9.17E-12	9.857E-10
Ac-227	2.180E+01	9.557E-11	Scaling factor	5.14E-08	0.00E+00	1.34E-08	4.25E-08	2.88E-09	1.46E-08	3.82E-10	6.12E-09	1.09E-08	8.85E-09	1.55E-08	7.26E-09	1.20E-08	1.46E-08	7.32E-08	3.03E-08	1.74E-08	1.33E-08	3.346E-07
Th-228	1.910E+00	1.715E-05	Scaling factor	9.23E-03	0.00E+00	2.40E-03	7.63E-03	5.17E-04	2.62E-03	6.85E-05	1.10E-03	1.96E-03	1.59E-03	2.78E-03	1.30E-03	2.15E-03	2.62E-03	1.31E-02	5.44E-03	3.13E-03	2.38E-03	6.005E-02
Th-229	7.300E+03	7.904E-13	Scaling factor	4.25E-10	0.00E+00	1.11E-10	3.52E-10	2.38E-11	1.21E-10	3.16E-12	5.06E-11	9.01E-11	7.32E-11	1.28E-10	6.01E-11	9.90E-11	1.21E-10	6.05E-10	2.51E-10	1.44E-10	1.10E-10	2.767E-09
Th-230	7.540E+04	1.379E-09	Scaling factor	7.42E-07	0.00E+00	1.93E-07	6.14E-07	4.15E-08	2.11E-07	5.51E-09	8.82E-08	1.57E-07	1.28E-07	2.23E-07	1.05E-07	1.73E-07	2.11E-07	1.06E-06	4.37E-07	2.51E-07	1.92E-07	4.827E-06
Th-232	1.400E+10	2.591E-15	Scaling factor	1.39E-12	0.00E+00	3.63E-13	1.15E-12	7.80E-14	3.96E-13	1.03E-14	1.66E-13	2.95E-13	2.40E-13	4.20E-13	1.97E-13	3.24E-13	3.96E-13	1.98E-12	8.21E-13	4.73E-13	3.60E-13	9.072E-12
Pa-231	3.280E+04	2.515E-10	Scaling factor	1.35E-07	0.00E+00	3.52E-08	1.12E-07	7.57E-09	3.84E-08	1.00E-09	1.61E-08	2.87E-08	2.33E-08	4.08E-08	1.91E-08	3.15E-08	3.85E-08	1.93E-07	7.97E-08	4.59E-08	3.50E-08	8.804E-07
U-232	6.890E+01	3.466E-08	Reverse decay	5.13E-08	0.00E+00	1.35E-08	4.14E-08	1.10E-08	2.49E-08	1.49E-09	2.36E-08	3.39E-08	3.40E-08	3.51E-08	2.79E-08	1.22E-05	1.54E-05	4.88E-05	1.80E-05	1.52E-06	5.10E-08	9.629E-05
U-233	1.592E+05	4.955E-11	Reverse decay	3.57E-08	0.00E+00	8.80E-09	2.60E-08	5.20E-10	7.21E-09	6.30E-11	9.60E-10	2.86E-09	1.32E-09	5.26E-09	9.80E-10	1.02E-09	1.22E-09	2.50E-08	1.07E-08	3.82E-09	1.39E-09	1.328E-07
U-234	2.455E+05	3.507E-06	Parent-daughter	6.66E-04	0.00E+00	1.74E-04	5.42E-04	1.08E-04	2.82E-04	1.50E-05	2.32E-04	3.37E-04	3.28E-04	3.67E-04	2.66E-04	5.34E-04	6.70E-04	2.59E-03	1.00E-03	5.83E-04	4.76E-04	9.171E-03
U-235	7.038E+08	2.287E-08	Parent-daughter	4.58E-06	0.00E+00	1.20E-06	3.79E-06	7.20E-07	1.92E-06	9.80E-08	1.60E-06	2.30E-06	2.22E-06	2.49E-06	1.82E-06	3.30E-06	4.10E-06	1.63E-05	6.31E-06	4.07E-06	3.39E-06	6.025E-05
U-236	2.342E+07	5.717E-08	Parent-daughter	1.05E-05	0.00E+00	2.82E-06	8.69E-06	1.92E-06	4.84E-06	2.60E-07	4.08E-06	5.94E-06	5.84E-06	6.39E-06	4.83E-06	8.40E-06	1.06E-05	4.27E-05	1.59E-05	1.05E-05	8.80E-06	1.530E-04
U-238	4.470E+09	1.182E-09	Parent-daughter	2.61E-07	0.00E+00	6.90E-08	2.15E-07	3.60E-08	1.02E-07	4.80E-09	7.68E-08	1.17E-07	1.11E-07	1.31E-07	9.10E-08	1.62E-07	2.04E-07	8.29E-07	3.19E-07	1.99E-07	1.64E-07	3.090E-06
Np-237	2.144E+06	3.430E-07	Parent-daughter	2.24E-04	0.00E+00	5.98E-05	1.86E-04	3.60E-06	5.26E-05	4.80E-07	7.60E-06	2.32E-05	1.11E-05	4.62E-05	9.10E-06	1.20E-06	1.46E-06	1.55E-04	6.99E-05	3.31E-05	1.62E-05	9.000E-04
Pu-238	8.770E+01	4.172E-03	Reverse decay	1.27E-01	0.00E+00	3.38E-02	1.04E-01	2.16E-01	3.02E-01	2.92E-02	4.63E-01	6.14E-01	6.61E-01	5.47E-01	5.46E-01	7.98E-01	9.62E-01	3.16E+00	1.18E+00	1.08E+00	9.95E-01	1.181E+01
Pu-239	2.411E+04	6.863E-05	Parent-daughter	1.11E-02	0.00E+00	2.82E-03	8.85E-03	2.32E-03	5.34E-03	3.10E-04	4.96E-03	7.22E-03	7.12E-03	7.41E-03	5.88E-03	1.02E-02	1.30E-02	5.04E-02	1.95E-02	1.26E-02	1.07E-02	1.797E-01
Pu-240	6.563E+03	5.344E-05	Parent-daughter	4.33E-03	0.00E+00	1.13E-03	3.50E-03	2.17E-03	3.69E-03	2.91E-04	4.57E-03	6.26E-03	6.60E-03	5.87E-03	5.40E-03	9.62E-03	1.16E-02	4.11E-02	1.59E-02	1.13E-02	9.95E-03	1.432E-01
Pu-241	1.435E+01	6.071E-03	Reverse decay	4.88E-01	0.00E+00	1.29E-01	4.02E-01	7.51E-01	1.05E+00	9.80E-02	1.59E+00	2.12E+00	2.29E+00	1.87E+00	1.87E+00	7.46E-01	9.42E-01	3.27E+00	1.22E+00	3.36E+00	3.46E+00	2.566E+01
Pu-242	3.733E+05	1.105E-07	Parent-daughter	3.26E-07	0.00E+00	8.60E-08	2.60E-07	4.80E-06	6.15E-06	6.40E-07	1.04E-05	1.32E-05	1.48E-05	1.16E-05	1.19E-05	2.22E-05	2.78E-05	8.96E-05	3.33E-05	2.36E-05	2.16E-05	2.922E-04
Pu-244	8.080E+07	1.677E-15	Parent-daughter	9.61E-15	0.00E+00	2.55E-15	7.95E-15	8.40E-19	2.20E-15	1.10E-19	1.76E-18	5.52E-16	2.51E-18	1.60E-15	2.10E-18	5.52E-13	6.88E-13	2.25E-12	8.30E-13	6.85E-14	3.80E-18	4.409E-12
Am-241	4.322E+02	2.963E-04	Parent-daughter	2.42E-02	0.00E+00	6.23E-03	1.98E-02	2.14E-02	3.17E-02	2.82E-03	4.33E-02	5.72E-02	6.08E-02	5.06E-02	4.81E-02	2.78E-02	3.38E-02	1.25E-01	4.70E-02	8.17E-02	7.64E-02	7.581E-01
Am-243	7.370E+03	2.799E-06	Reverse decay	8.61E-08	0.00E+00	2.26E-08	7.00E-08	2.81E-10	1.90E-08	3.71E-11	6.02E-10	5.59E-09	8.81E-10	1.52E-08	7.02E-10	2.41E-04	3.03E-04	9.77E-04	3.64E-04	3.01E-05	1.27E-09	1.914E-03
Cm-243	2.910E+01	8.863E-08	Scaling factor	4.77E-05	0.00E+00	1.24E-05	3.94E-05	2.67E-06	1.35E-05	3.54E-07	5.67E-06	1.01E-05	8.21E-06	1.44E-05	6.73E-06	1.11E-05	1.36E-05	6.78E-05	2.81E-05	1.62E-05	1.23E-05	3.103E-04
Cm-244	1.810E+01	5.449E-06	Scaling factor	2.93E-03	0.00E+00	7.64E-04	2.43E-03	1.64E-04	8.33E-04	2.18E-05	3.49E-04	6.21E-04	5.05E-04	8.83E-04	4.14E-04	6.82E-04	8.33E-04	4.17E-03	1.73E-03	9.94E-04	7.57E-04	1.907E-02
Cm-245	8.500E+03	4.925E-10	Scaling factor	2.65E-07	0.00E+00	6.90E-08	2.19E-07	1.48E-08	7.53E-08	1.97E-09	3.15E-08	5.62E-08	4.56E-08	7.98E-08	3.74E-08	6.17E-08	7.53E-08	3.77E-07	1.56E-07	8.98E-08	6.85E-08	1.724E-06
Cm-246	4.760E+03	3.911E-11	Scaling factor	2.10E-08	0.00E+00	5.48E-09	1.74E-08	1.18E-09	5.98E-09	1.56E-10	2.50E-09	4.46E-09	3.62E-09	6.34E-09	2.97E-09	4.90E-09	5.98E-09	2.99E-08	1.24E-08	7.13E-09	5.44E-09	1.369E-07
Cm-247	1.560E+07	5.053E-17	Scaling factor	2.72E-14	0.00E+00	7.08E-15	2.25E-14	1.52E-15	7.72E-15	2.02E-16	3.23E-15	5.76E-15	4.68E-15	8.19E-15	3.84E-15	6.33E-15	7.73E-15	3.87E-14	1.60E-14	9.21E-15	7.02E-15	1.769E-13
Cm-248	3.480E+05	6.135E-17	Scaling factor	3.30E-14	0.00E+00	8.60E-15	2.73E-14	1.85E-15	9.38E-15	2.45E-16	3.93E-15	7.00E-15	5.68E-15	9.94E-15	4.66E-15	7.68E-15	9.38E-15	4.70E-14	1.94E-14	1.12E-14	8.53E-15	2.148E-13
Total =				1.07E+03	0.00E+00	2.78E+02	8.79E+02	7.45E+01	3.25E+02	9.84E+00	1.59E+02	2.67E+02	2.28E+02	3.56E+02	1.88E+02	2.47E+02	3.01E+02	1.51E+03	6.29E+02	4.26E+02	3.42E+02	7.28E+03

a. Table values were primarily computed based on the data shown in Table 1.
b. The analysis methodology pertains to the back-decay calculations (e.g., reverse decay or parent-daughter calculation from the Table 1 data), or the scaling calculations that were made to determine the reported value.

Table E-5. Upper-bound inventory (Ci) for the 183 Waste Calcining Facility filters shipped from INTEC to RWMC (results are computed for the year of shipment).[a]

Upper	Shipping date =	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	—
Bound	Table values on =	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	—
	Shipping sequence =	1 – 12	none	13 – 17	18 – 32	33 – 36	37 – 44	45	46 – 53	54 – 60	61 – 68	69 – 80	81 – 87	88 – 93	94 – 101	102 – 136	137 – 152	153 – 166	167 – 183	
Nuclide	Half-life (y)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)
H-3	1.233E+01	5.92E+00	0.00E+00	1.54E+00	4.99E+00	6.16E-01	2.08E+00	8.26E-02	1.35E+00	2.07E+00	1.92E+00	2.46E+00	1.54E+00	1.25E+00	1.60E+00	7.37E+00	2.96E+00	3.14E+00	2.81E+00	4.369E+01
Be-10	1.151E+06	4.95E-08	0.00E+00	1.31E-08	3.95E-08	1.80E-09	1.31E-08	2.43E-10	3.84E-09	7.83E-09	5.55E-09	1.26E-08	4.62E-09	1.19E-08	1.49E-08	8.12E-08	3.29E-08	1.33E-08	8.22E-09	3.141E-07
C-14	5.730E+03	1.99E-06	0.00E+00	5.24E-07	1.63E-06	7.35E-08	5.27E-07	9.94E-09	1.59E-07	3.10E-07	2.24E-07	5.09E-07	1.87E-07	4.87E-07	5.96E-07	3.25E-06	1.32E-06	5.44E-07	3.40E-07	1.269E-05
Cl-36	3.010E+05	1.42E-09	0.00E+00	3.71E-10	1.18E-09	7.97E-11	4.04E-10	1.06E-11	1.69E-10	3.02E-10	2.45E-10	4.29E-10	2.01E-10	3.31E-10	4.05E-10	2.03E-09	8.39E-10	4.82E-10	3.68E-10	9.262E-09
Co-60	5.271E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.21E+00	1.52E+00	1.55E-01	2.50E+00	3.29E+00	3.56E+00	2.84E+00	2.98E+00	5.49E-01	7.04E-01	2.31E+00	8.49E-01	5.20E+00	5.47E+00	3.314E+01
Ni-59	7.600E+04	5.40E-03	0.00E+00	1.41E-03	4.46E-03	3.02E-04	1.53E-03	4.01E-05	6.42E-04	1.14E-03	9.29E-04	1.63E-03	7.62E-04	1.26E-03	1.53E-03	7.68E-03	3.18E-03	1.83E-03	1.39E-03	3.511E-02
Ni-63	1.001E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.44E-02	4.54E-02	4.80E-03	7.63E-02	9.83E-02	1.07E-01	8.37E-02	8.99E-02	1.30E-01	1.62E-01	5.29E-01	1.95E-01	1.76E-01	1.63E-01	1.895E+00
Sr-90	2.878E+01	1.56E+03	0.00E+00	4.08E+02	1.28E+03	1.22E+02	4.96E+02	1.61E+01	2.61E+02	4.27E+02	3.71E+02	5.51E+02	3.07E+02	3.53E+02	4.28E+02	2.17E+03	9.13E+02	6.81E+02	5.58E+02	1.091E+04
Nb-94	2.030E+04	3.89E-07	0.00E+00	1.02E-07	3.14E-07	1.44E-08	1.02E-07	1.86E-09	2.88E-08	5.95E-08	4.20E-08	9.79E-08	3.57E-08	8.83E-08	1.10E-07	6.14E-07	2.51E-07	1.03E-07	6.39E-08	2.418E-06
Tc-99	2.111E+05	2.46E-01	0.00E+00	6.42E-02	2.03E-01	9.00E-03	6.48E-02	1.20E-03	1.94E-02	3.90E-02	2.70E-02	6.24E-02	2.31E-02	5.58E-02	7.08E-02	3.92E-01	1.60E-01	6.63E-02	4.14E-02	1.545E+00
I-129	1.570E+07	3.94E-04	0.00E+00	1.05E-04	3.28E-04	1.44E-05	1.02E-04	1.98E-06	3.12E-05	6.39E-05	4.44E-05	1.01E-04	3.78E-05	9.36E-05	1.16E-04	6.42E-04	2.59E-04	1.08E-04	6.78E-05	2.510E-03
Cs-137	3.007E+01	1.61E+03	0.00E+00	4.20E+02	1.34E+03	9.03E+01	4.59E+02	1.20E+01	1.92E+02	3.42E+02	2.78E+02	4.86E+02	2.28E+02	3.76E+02	4.59E+02	2.30E+03	9.51E+02	5.47E+02	4.17E+02	1.050E+04
Eu-152	1.354E+01	6.08E-02	0.00E+00	1.59E-02	5.07E-02	1.79E-02	3.55E-02	2.37E-03	3.81E-02	5.32E-02	5.50E-02	5.33E-02	4.53E-02	4.12E-02	5.10E-02	1.90E-01	7.24E-02	8.79E-02	8.20E-02	9.525E-01
Eu-154	8.593E+00	1.57E+01	0.00E+00	4.10E+00	1.28E+01	6.34E+00	1.14E+01	8.43E-01	1.34E+01	1.81E+01	1.93E+01	1.77E+01	1.58E+01	5.61E+00	6.94E+00	2.72E+01	1.07E+01	2.90E+01	2.93E+01	2.442E+02
Pb-210	2.230E+01	4.20E-09	0.00E+00	1.09E-09	3.48E-09	2.35E-10	1.19E-09	3.12E-11	5.00E-10	8.91E-10	7.23E-10	1.27E-09	5.93E-10	9.78E-10	1.19E-09	5.98E-09	2.48E-09	1.42E-09	1.09E-09	2.734E-08
Ra-226	1.600E+03	8.11E-07	0.00E+00	2.10E-07	6.79E-07	6.33E-10	1.77E-07	7.29E-11	1.12E-09	4.69E-08	1.37E-09	1.36E-07	9.76E-10	3.46E-09	4.00E-09	5.55E-07	2.51E-07	6.30E-08	1.03E-09	2.941E-06
Ra-228	5.750E+00	9.71E-10	0.00E+00	2.53E-10	7.85E-10	6.25E-12	2.17E-10	8.26E-13	1.35E-11	7.12E-11	1.85E-11	1.77E-10	1.54E-11	1.17E-11	1.30E-11	2.28E-10	9.97E-11	4.97E-11	2.75E-11	2.957E-09
Ac-227	2.180E+01	1.54E-07	0.00E+00	4.02E-08	1.28E-07	8.63E-09	4.38E-08	1.15E-09	1.84E-08	3.27E-08	2.66E-08	4.65E-08	2.18E-08	3.59E-08	4.38E-08	2.19E-07	9.09E-08	5.23E-08	3.99E-08	1.004E-06
Th-228	1.910E+00	2.77E-02	0.00E+00	7.21E-03	2.29E-02	1.55E-03	7.87E-03	2.06E-04	3.29E-03	5.87E-03	4.77E-03	8.34E-03	3.91E-03	6.44E-03	7.87E-03	3.94E-02	1.63E-02	9.38E-03	7.15E-03	1.802E-01
Th-229	7.300E+03	1.28E-09	0.00E+00	3.32E-10	1.06E-09	7.14E-11	3.62E-10	9.47E-12	1.52E-10	2.70E-10	2.20E-10	3.84E-10	1.80E-10	2.97E-10	3.63E-10	1.82E-09	7.52E-10	4.32E-10	3.30E-10	8.301E-09
Th-230	7.540E+04	2.23E-06	0.00E+00	5.80E-07	1.84E-06	1.25E-07	6.32E-07	1.65E-08	2.65E-07	4.72E-07	3.83E-07	6.70E-07	3.14E-07	5.18E-07	6.33E-07	3.17E-06	1.31E-06	7.54E-07	5.75E-07	1.448E-05
Th-232	1.400E+10	4.18E-12	0.00E+00	1.09E-12	3.46E-12	2.34E-13	1.19E-12	3.10E-14	4.98E-13	8.86E-13	7.20E-13	1.26E-12	5.91E-13	9.73E-13	1.19E-12	5.95E-12	2.46E-12	1.42E-12	1.08E-12	2.722E-11
Pa-231	3.280E+04	4.06E-07	0.00E+00	1.06E-07	3.36E-07	2.27E-08	1.15E-07	3.01E-09	4.83E-08	8.60E-08	6.99E-08	1.22E-07	5.73E-08	9.45E-08	1.15E-07	5.78E-07	2.39E-07	1.38E-07	1.05E-07	2.641E-06
U-232	6.890E+01	1.54E-07	0.00E+00	4.05E-08	1.24E-07	3.31E-08	7.46E-08	4.46E-09	7.07E-08	1.02E-07	1.02E-07	1.05E-07	8.37E-08	3.67E-05	4.61E-05	1.46E-04	5.41E-05	4.56E-06	1.53E-07	2.889E-04
U-233	1.592E+05	1.07E-07	0.00E+00	2.64E-08	7.80E-08	1.56E-09	2.16E-08	1.89E-10	2.88E-09	8.58E-09	3.96E-09	1.58E-08	2.94E-09	3.06E-09	3.66E-09	7.49E-08	3.22E-08	1.15E-08	4.17E-09	3.984E-07
U-234	2.455E+05	2.00E-03	0.00E+00	5.22E-04	1.63E-03	3.24E-04	8.46E-04	4.50E-05	6.95E-04	1.01E-03	9.83E-04	1.10E-03	7.97E-04	1.60E-03	2.01E-03	7.78E-03	3.00E-03	1.75E-03	1.43E-03	2.751E-02
U-235	7.038E+08	1.37E-05	0.00E+00	3.60E-06	1.14E-05	2.16E-06	5.75E-06	2.94E-07	4.80E-06	6.90E-06	6.66E-06	7.47E-06	5.46E-06	9.90E-06	1.23E-05	4.90E-05	1.89E-05	1.22E-05	1.02E-05	1.807E-04
U-236	2.342E+07	3.15E-05	0.00E+00	8.46E-06	2.61E-05	5.76E-06	1.45E-05	7.80E-07	1.22E-05	1.78E-05	1.75E-05	1.92E-05	1.45E-05	2.52E-05	3.18E-05	1.28E-04	4.78E-05	3.14E-05	2.64E-05	4.590E-04
U-238	4.470E+09	7.83E-07	0.00E+00	2.07E-07	6.45E-07	1.08E-07	3.05E-07	1.44E-08	2.30E-07	3.51E-07	3.33E-07	3.92E-07	2.73E-07	4.86E-07	6.12E-07	2.49E-06	9.56E-07	5.97E-07	4.92E-07	9.271E-06
Np-237	2.144E+06	6.71E-04	0.00E+00	1.79E-04	5.58E-04	1.08E-05	1.58E-04	1.44E-06	2.28E-05	6.96E-05	3.33E-05	1.39E-04	2.73E-05	3.60E-06	4.38E-06	4.64E-04	2.10E-04	9.93E-05	4.86E-05	2.700E-03
Pu-238	8.770E+01	3.82E-01	0.00E+00	1.01E-01	3.12E-01	6.49E-01	9.05E-01	8.75E-02	1.39E+00	1.84E+00	1.98E+00	1.64E+00	1.64E+00	2.39E+00	2.89E+00	9.47E+00	3.53E+00	3.25E+00	2.98E+00	3.544E+01
Pu-239	2.411E+04	3.32E-02	0.00E+00	8.47E-03	2.65E-02	6.97E-03	1.60E-02	9.31E-04	1.49E-02	2.16E-02	2.13E-02	2.22E-02	1.77E-02	3.06E-02	3.90E-02	1.51E-01	5.84E-02	3.79E-02	3.20E-02	5.390E-01
Pu-240	6.563E+03	1.30E-02	0.00E+00	3.40E-03	1.05E-02	6.50E-03	1.11E-02	8.73E-04	1.37E-02	1.88E-02	1.98E-02	1.76E-02	1.62E-02	2.89E-02	3.49E-02	1.23E-01	4.76E-02	3.38E-02	2.98E-02	4.297E-01
Pu-241	1.435E+01	1.46E+00	0.00E+00	3.88E-01	1.21E+00	2.25E+00	3.16E+00	2.94E-01	4.77E+00	6.35E+00	6.86E+00	5.62E+00	5.62E+00	2.24E+00	2.82E+00	9.81E+00	3.67E+00	1.01E+01	1.04E+01	7.699E+01
Pu-242	3.733E+05	9.78E-07	0.00E+00	2.58E-07	7.80E-07	1.44E-05	1.85E-05	1.92E-06	3.12E-05	3.97E-05	4.44E-05	3.47E-05	3.57E-05	6.66E-05	8.34E-05	2.69E-04	9.99E-05	7.08E-05	6.48E-05	8.767E-04
Pu-244	8.080E+07	2.88E-14	0.00E+00	7.65E-15	2.39E-14	2.52E-18	6.60E-15	3.30E-19	5.28E-18	1.66E-15	7.53E-18	4.81E-15	6.30E-18	1.66E-12	2.06E-12	6.74E-12	2.49E-12	2.06E-13	1.14E-17	1.323E-11
Am-241	4.322E+02	7.26E-02	0.00E+00	1.87E-02	5.95E-02	6.41E-02	9.50E-02	8.45E-03	1.30E-01	1.71E-01	1.82E-01	1.52E-01	1.44E-01	8.35E-02	1.02E-01	3.76E-01	1.41E-01	2.45E-01	2.29E-01	2.274E+00
Am-243	7.370E+03	2.58E-07	0.00E+00	6.77E-08	2.10E-07	8.43E-10	5.70E-08	1.11E-10	1.80E-09	1.68E-08	2.64E-09	4.56E-08	2.10E-09	7.22E-04	9.08E-04	2.93E-03	1.09E-03	9.02E-05	3.82E-09	5.743E-03
Cm-243	2.910E+01	1.43E-04	0.00E+00	3.73E-05	1.18E-04	8.01E-06	4.06E-05	1.06E-06	1.70E-05	3.03E-05	2.46E-05	4.31E-05	2.02E-05	3.33E-05	4.07E-05	2.04E-04	8.43E-05	4.85E-05	3.70E-05	9.308E-04
Cm-244	1.810E+01	8.79E-03	0.00E+00	2.29E-03	7.28E-03	4.92E-04	2.50E-03	6.53E-05	1.05E-03	1.86E-03	1.51E-03	2.65E-03	1.24E-03	2.05E-03	2.50E-03	1.25E-02	5.18E-03	2.98E-03	2.27E-03	5.722E-02
Cm-245	8.500E+03	7.95E-07	0.00E+00	2.07E-07	6.58E-07	4.45E-08	2.26E-07	5.90E-09	9.46E-08	1.68E-07	1.37E-07	2.39E-07	1.12E-07	1.85E-07	2.26E-07	1.13E-06	4.68E-07	2.69E-07	2.05E-07	5.173E-06
Cm-246	4.760E+03	6.31E-08	0.00E+00	1.64E-08	5.22E-08	3.53E-09	1.79E-08	4.69E-10	7.51E-09	1.34E-08	1.09E-08	1.90E-08	8.91E-09	1.47E-08	1.79E-08	8.98E-08	3.72E-08	2.14E-08	1.63E-08	4.107E-07
Cm-247	1.560E+07	8.15E-14	0.00E+00	2.12E-14	6.75E-14	4.56E-15	2.32E-14	6.05E-16	9.70E-15	1.73E-14	1.40E-14	2.46E-14	1.15E-14	1.90E-14	2.32E-14	1.16E-13	4.80E-14	2.76E-14	2.11E-14	5.306E-13
Cm-248	3.480E+05	9.90E-14	0.00E+00	2.58E-14	8.19E-14	5.54E-15	2.81E-14	7.35E-16	1.18E-14	2.10E-14	1.70E-14	2.98E-14	1.40E-14	2.30E-14	2.81E-14	1.41E-13	5.83E-14	3.36E-14	2.56E-14	6.443E-13
Total =		3.20E+03	0.00E+00	8.35E+02	2.64E+03	2.23E+02	9.74E+02	2.95E+01	4.76E+02	8.02E+02	6.83E+02	1.07E+03	5.63E+02	7.41E+02	9.02E+02	4.53E+03	1.89E+03	1.28E+03	1.03E+03	2.185E+04

a. The upper-bound results are a factor of three higher than the best-estimate results.

Table E-6. Lower-bound inventory (Ci) for the 183 WCF filters shipped to RWMC from INTEC (results are computed for the year of shipment).[a]

Lower	Shipping date =	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	—
Bound	Table values on =	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	—
	Shipping sequence	1 – 12	none	13 – 17	18 – 32	33 – 36	37 – 44	45	46 – 53	54 – 60	61 – 68	69 – 80	81 – 87	88 – 93	94 – 101	102 – 136	137 – 152	153 – 166	167 – 183	Sum
Nuclide	Half-life (y)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)	(Ci)
H-3	1.233E+01	6.58E-01	0.00E+00	1.71E-01	5.54E-01	6.85E-02	2.32E-01	9.18E-03	1.50E-01	2.30E-01	2.13E-01	2.73E-01	1.71E-01	1.39E-01	1.77E-01	8.19E-01	3.29E-01	3.49E-01	3.12E-01	4.855E+00
Be-10	1.151E+06	5.50E-09	0.00E+00	1.46E-09	4.39E-09	2.00E-10	1.45E-09	2.70E-11	4.27E-10	8.70E-10	6.17E-10	1.40E-09	5.13E-10	1.32E-09	1.66E-09	9.02E-09	3.65E-09	1.48E-09	9.13E-10	3.490E-08
C-14	5.730E+03	2.21E-07	0.00E+00	5.82E-08	1.81E-07	8.16E-09	5.86E-08	1.10E-09	1.77E-08	3.44E-08	2.48E-08	5.65E-08	2.08E-08	5.42E-08	6.62E-08	3.62E-07	1.47E-07	6.05E-08	3.78E-08	1.410E-06
Cl-36	3.010E+05	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Co-60	5.271E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.34E-01	1.69E-01	1.72E-02	2.78E-01	3.65E-01	3.96E-01	3.16E-01	3.31E-01	6.10E-02	7.82E-02	2.56E-01	9.43E-02	5.78E-01	6.08E-01	3.683E+00
Ni-59	7.600E+04	6.00E-04	0.00E+00	1.56E-04	4.96E-04	3.36E-05	1.70E-04	4.45E-06	7.13E-05	1.27E-04	1.03E-04	1.81E-04	8.47E-05	1.40E-04	1.70E-04	8.53E-04	3.53E-04	2.03E-04	1.55E-04	3.901E-03
Ni-63	1.001E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.83E-03	5.04E-03	5.33E-04	8.48E-03	1.09E-02	1.19E-02	9.30E-03	9.99E-03	1.44E-02	1.80E-02	5.87E-02	2.17E-02	1.96E-02	1.81E-02	2.105E-01
Sr-90	2.878E+01	1.73E+02	0.00E+00	4.54E+01	1.42E+02	1.35E+01	5.51E+01	1.79E+00	2.90E+01	4.75E+01	4.12E+01	6.12E+01	3.41E+01	3.92E+01	4.76E+01	2.42E+02	1.01E+02	7.57E+01	6.21E+01	1.212E+03
Nb-94	2.030E+04	4.32E-08	0.00E+00	1.13E-08	3.49E-08	1.60E-09	1.14E-08	2.07E-10	3.20E-09	6.61E-09	4.67E-09	1.09E-08	3.97E-09	9.81E-09	1.23E-08	6.82E-08	2.79E-08	1.15E-08	7.10E-09	2.687E-07
Tc-99	2.111E+05	2.73E-02	0.00E+00	7.13E-03	2.25E-02	1.00E-03	7.20E-03	1.33E-04	2.16E-03	4.33E-03	3.00E-03	6.93E-03	2.57E-03	6.20E-03	7.87E-03	4.35E-02	1.78E-02	7.37E-03	4.60E-03	1.717E-01
I-129	1.570E+07	4.37E-05	0.00E+00	1.17E-05	3.64E-05	1.60E-06	1.14E-05	2.20E-07	3.47E-06	7.10E-06	4.93E-06	1.13E-05	4.20E-06	1.04E-05	1.29E-05	7.14E-05	2.88E-05	1.20E-05	7.53E-06	2.789E-04
Cs-137	3.007E+01	1.79E+02	0.00E+00	4.67E+01	1.48E+02	1.00E+01	5.09E+01	1.33E+00	2.13E+01	3.80E+01	3.09E+01	5.40E+01	2.53E+01	4.17E+01	5.10E+01	2.55E+02	1.06E+02	6.08E+01	4.63E+01	1.167E+03
Eu-152	1.354E+01	6.76E-03	0.00E+00	1.77E-03	5.63E-03	1.99E-03	3.94E-03	2.63E-04	4.24E-03	5.91E-03	6.11E-03	5.92E-03	5.03E-03	4.58E-03	5.67E-03	2.11E-02	8.05E-03	9.77E-03	9.12E-03	1.058E-01
Eu-154	8.593E+00	1.75E+00	0.00E+00	4.55E-01	1.42E+00	7.05E-01	1.27E+00	9.37E-02	1.49E+00	2.01E+00	2.14E+00	1.97E+00	1.75E+00	6.24E-01	7.71E-01	3.03E+00	1.18E+00	3.22E+00	3.26E+00	2.714E+01
Pb-210	2.230E+01	4.67E-10	0.00E+00	1.22E-10	3.86E-10	2.61E-11	1.33E-10	3.47E-12	5.55E-11	9.90E-11	8.04E-11	1.41E-10	6.59E-11	1.09E-10	1.33E-10	6.64E-10	2.75E-10	1.58E-10	1.21E-10	3.038E-09
Ra-226	1.600E+03	9.01E-08	0.00E+00	2.33E-08	7.54E-08	7.03E-11	1.97E-08	8.10E-12	1.24E-10	5.21E-09	1.52E-10	1.51E-08	1.08E-10	3.84E-10	4.44E-10	6.16E-08	2.79E-08	7.00E-09	1.14E-10	3.268E-07
Ra-228	5.750E+00	1.08E-10	0.00E+00	2.81E-11	8.72E-11	6.94E-13	2.41E-11	9.18E-14	1.50E-12	7.91E-12	2.06E-12	1.96E-11	1.71E-12	1.30E-12	1.44E-12	2.53E-11	1.11E-11	5.52E-12	3.06E-12	3.286E-10
Ac-227	2.180E+01	1.71E-08	0.00E+00	4.46E-09	1.42E-08	9.59E-10	4.87E-09	1.27E-10	2.04E-09	3.63E-09	2.95E-09	5.16E-09	2.42E-09	3.99E-09	4.87E-09	2.44E-08	1.01E-08	5.81E-09	4.43E-09	1.115E-07
Th-228	1.910E+00	3.08E-03	0.00E+00	8.01E-04	2.54E-03	1.72E-04	8.74E-04	2.28E-05	3.66E-04	6.52E-04	5.30E-04	9.27E-04	4.34E-04	7.16E-04	8.74E-04	4.38E-03	1.81E-03	1.04E-03	7.95E-04	2.002E-02
Th-229	7.300E+03	1.42E-10	0.00E+00	3.69E-11	1.17E-10	7.93E-12	4.03E-11	1.05E-12	1.69E-11	3.00E-11	2.44E-11	4.27E-11	2.00E-11	3.30E-11	4.03E-11	2.02E-10	8.35E-11	4.80E-11	3.66E-11	9.224E-10
Th-230	7.540E+04	2.47E-07	0.00E+00	6.44E-08	2.05E-07	1.38E-08	7.02E-08	1.84E-09	2.94E-08	5.24E-08	4.26E-08	7.45E-08	3.49E-08	5.75E-08	7.03E-08	3.52E-07	1.46E-07	8.38E-08	6.39E-08	1.609E-06
Th-232	1.400E+10	4.65E-13	0.00E+00	1.21E-13	3.84E-13	2.60E-14	1.32E-13	3.45E-15	5.53E-14	9.85E-14	8.00E-14	1.40E-13	6.56E-14	1.08E-13	1.32E-13	6.61E-13	2.74E-13	1.58E-13	1.20E-13	3.024E-12
Pa-231	3.280E+04	4.51E-08	0.00E+00	1.17E-08	3.73E-08	2.52E-09	1.28E-08	3.35E-10	5.37E-09	9.56E-09	7.76E-09	1.36E-08	6.37E-09	1.05E-08	1.28E-08	6.42E-08	2.66E-08	1.53E-08	1.17E-08	2.935E-07
U-232	6.890E+01	1.71E-08	0.00E+00	4.51E-09	1.38E-08	3.68E-09	8.29E-09	4.96E-10	7.85E-09	1.13E-08	1.13E-08	1.17E-08	9.30E-09	4.07E-06	5.13E-06	1.63E-05	6.01E-06	5.06E-07	1.70E-08	3.210E-05
U-233	1.592E+05	1.19E-08	0.00E+00	2.93E-09	8.67E-09	1.73E-10	2.40E-09	2.10E-11	3.20E-10	9.53E-10	4.40E-10	1.75E-09	3.27E-10	3.40E-10	4.07E-10	8.32E-09	3.58E-09	1.27E-09	4.63E-10	4.427E-08
U-234	2.455E+05	2.22E-04	0.00E+00	5.80E-05	1.81E-04	3.60E-05	9.39E-05	4.99E-06	7.73E-05	1.12E-04	1.09E-04	1.22E-04	8.86E-05	1.78E-04	2.23E-04	8.65E-04	3.34E-04	1.94E-04	1.59E-04	3.057E-03
U-235	7.038E+08	1.53E-06	0.00E+00	4.00E-07	1.26E-06	2.40E-07	6.39E-07	3.27E-08	5.33E-07	7.67E-07	7.40E-07	8.30E-07	6.07E-07	1.10E-06	1.37E-06	5.45E-06	2.10E-06	1.36E-06	1.13E-06	2.008E-05
U-236	2.342E+07	3.50E-06	0.00E+00	9.40E-07	2.90E-06	6.40E-07	1.61E-06	8.67E-08	1.36E-06	1.98E-06	1.95E-06	2.13E-06	1.61E-06	2.80E-06	3.53E-06	1.42E-05	5.31E-06	3.49E-06	2.93E-06	5.101E-05
U-238	4.470E+09	8.70E-08	0.00E+00	2.30E-08	7.17E-08	1.20E-08	3.39E-08	1.60E-09	2.56E-08	3.90E-08	3.70E-08	4.35E-08	3.03E-08	5.40E-08	6.80E-08	2.76E-07	1.06E-07	6.63E-08	5.47E-08	1.030E-06
Np-237	2.144E+06	7.46E-05	0.00E+00	1.99E-05	6.20E-05	1.20E-06	1.75E-05	1.60E-07	2.53E-06	7.73E-06	3.70E-06	1.54E-05	3.03E-06	4.00E-07	4.87E-07	5.16E-05	2.33E-05	1.10E-05	5.40E-06	3.000E-04
Pu-238	8.770E+01	4.24E-02	0.00E+00	1.13E-02	3.47E-02	7.21E-02	1.01E-01	9.72E-03	1.54E-01	2.05E-01	2.20E-01	1.82E-01	1.82E-01	2.66E-01	3.21E-01	1.05E+00	3.92E-01	3.61E-01	3.32E-01	3.938E+00
Pu-239	2.411E+04	3.69E-03	0.00E+00	9.41E-04	2.95E-03	7.74E-04	1.78E-03	1.03E-04	1.65E-03	2.41E-03	2.37E-03	2.47E-03	1.96E-03	3.40E-03	4.34E-03	1.68E-02	6.49E-03	4.21E-03	3.55E-03	5.989E-02
Pu-240	6.563E+03	1.44E-03	0.00E+00	3.78E-04	1.17E-03	7.22E-04	1.23E-03	9.70E-05	1.52E-03	2.09E-03	2.20E-03	1.96E-03	1.80E-03	3.21E-03	3.88E-03	1.37E-02	5.29E-03	3.75E-03	3.32E-03	4.775E-02
Pu-241	1.435E+01	1.63E-01	0.00E+00	4.31E-02	1.34E-01	2.50E-01	3.52E-01	3.27E-02	5.30E-01	7.05E-01	7.63E-01	6.25E-01	6.24E-01	2.49E-01	3.14E-01	1.09E+00	4.08E-01	1.12E+00	1.15E+00	8.554E+00
Pu-242	3.733E+05	1.09E-07	0.00E+00	2.87E-08	8.67E-08	1.60E-06	2.05E-06	2.13E-07	3.47E-06	4.41E-06	4.93E-06	3.85E-06	3.97E-06	7.40E-06	9.27E-06	2.99E-05	1.11E-05	7.87E-06	7.20E-06	9.741E-05
Pu-244	8.080E+07	3.20E-15	0.00E+00	8.50E-16	2.65E-15	2.80E-19	7.34E-16	3.67E-20	5.87E-19	1.84E-16	8.37E-19	5.34E-16	7.00E-19	1.84E-13	2.29E-13	7.49E-13	2.77E-13	2.28E-14	1.27E-18	1.470E-12
Am-241	4.322E+02	8.07E-03	0.00E+00	2.08E-03	6.61E-03	7.12E-03	1.06E-02	9.39E-04	1.44E-02	1.91E-02	2.03E-02	1.69E-02	1.60E-02	9.28E-03	1.13E-02	4.18E-02	1.57E-02	2.72E-02	2.55E-02	2.527E-01
Am-243	7.370E+03	2.87E-08	0.00E+00	7.52E-09	2.33E-08	9.36E-11	6.34E-09	1.24E-11	2.01E-10	1.86E-09	2.94E-10	5.07E-09	2.34E-10	8.02E-05	1.01E-04	3.26E-04	1.21E-04	1.00E-05	4.24E-10	6.381E-04
Cm-243	2.910E+01	1.59E-05	0.00E+00	4.14E-06	1.31E-05	8.90E-07	4.52E-06	1.18E-07	1.89E-06	3.37E-06	2.74E-06	4.79E-06	2.24E-06	3.70E-06	4.52E-06	2.26E-05	9.36E-06	5.39E-06	4.11E-06	1.034E-04
Cm-244	1.810E+01	9.77E-04	0.00E+00	2.55E-04	8.08E-04	5.47E-05	2.78E-04	7.25E-06	1.16E-04	2.07E-04	1.68E-04	2.94E-04	1.38E-04	2.27E-04	2.78E-04	1.39E-03	5.76E-04	3.31E-04	2.52E-04	6.358E-03
Cm-245	8.500E+03	8.83E-08	0.00E+00	2.30E-08	7.31E-08	4.94E-09	2.51E-08	6.56E-10	1.05E-08	1.87E-08	1.52E-08	2.66E-08	1.25E-08	2.06E-08	2.51E-08	1.26E-07	5.20E-08	2.99E-08	2.28E-08	5.747E-07
Cm-246	4.760E+03	7.01E-09	0.00E+00	1.83E-09	5.80E-09	3.93E-10	1.99E-09	5.21E-11	8.34E-10	1.49E-09	1.21E-09	2.11E-09	9.91E-10	1.63E-09	1.99E-09	9.98E-09	4.13E-09	2.38E-09	1.81E-09	4.564E-08
Cm-247	1.560E+07	9.06E-15	0.00E+00	2.36E-15	7.50E-15	5.07E-16	2.57E-15	6.73E-17	1.08E-15	1.92E-15	1.56E-15	2.73E-15	1.28E-15	2.11E-15	2.58E-15	1.29E-14	5.34E-15	3.07E-15	2.34E-15	5.896E-14
Cm-248	3.480E+05	1.10E-14	0.00E+00	2.87E-15	9.10E-15	6.16E-16	3.13E-15	8.17E-17	1.31E-15	2.33E-15	1.89E-15	3.31E-15	1.55E-15	2.56E-15	3.13E-15	1.57E-14	6.48E-15	3.73E-15	2.84E-15	7.159E-14
Total =	—	3.55E+02	0.00E+00	9.28E+01	2.93E+02	2.48E+01	1.08E+02	3.28E+00	5.29E+01	8.91E+01	7.58E+01	1.19E+02	6.25E+01	8.23E+01	1.00E+02	5.03E+02	2.10E+02	1.42E+02	1.14E+02	2.428E+03

a. The lower-bound results represent a factor of one-third (1/3) of the best-estimate results.

Table E-7. Best-estimate cumulative activity contained within the 183 calcine-contaminated filters that were disposed of at the SDA from INTEC shipments made from 1964 through 1981.

Nuclide	Half-life (y)	Best-estimate total activity computed from all disposal dates (Ci)	Best-estimate total activity decay corrected to the year 2000 (Ci)	Wenzel's data reported for the year 2000[a] (Ci)
H-3	1.233E+01	1.456E+01	3.377E+00	3.383E+00
Be-10	1.151E+06	1.047E-07	1.047E-07	1.049E-07
C-14	5.730E+03	4.229E-06	4.216E-06	4.225E-06
Cl-36	3.010E+05	—	—	—
Co-60	5.271E+00	1.105E+01	5.185E-01	5.192E-01
Ni-59	7.600E+04	1.170E-02	1.170E-02	—
Ni-63	1.001E+02	6.315E-01	5.376E-01	5.360E-01
Sr-90	2.878E+01	3.635E+03	1.922E+03	1.923E+03
Nb-94	2.030E+04	8.060E-07	8.052E-07	8.051E-07
Tc-99	2.111E+05	5.150E-01	5.149E-01	5.149E-01
I-129	1.570E+07	8.368E-04	8.368E-04	8.395E-04
Cs-137	3.007E+01	3.501E+03	1.895E+03	1.892E+03
Eu-152	1.354E+01	3.175E-01	9.050E-02	9.055E-02
Eu-154	8.593E+00	8.141E+01	1.125E+01	1.127E+01
Pb-210	2.230E+01	9.115E-09	4.000E-09	—
Ra-226	1.600E+03	9.803E-07	9.677E-07	9.639E-07
Ra-228	5.750E+00	9.857E-10	2.718E-11	2.727E-11
Ac-227	2.180E+01	3.346E-07	1.441E-07	—
Th-228	1.910E+00	6.005E-02	1.342E-05	—
Th-229	7.300E+03	2.767E-09	2.760E-09	—
Th-230	7.540E+04	4.827E-06	4.826E-06	—
Th-232	1.400E+10	9.072E-12	9.072E-12	—
Pa-231	3.280E+04	8.804E-07	8.799E-07	—
U-232	6.890E+01	9.629E-05	7.700E-05	7.829E-05
U-233	1.592E+05	1.328E-07	1.328E-07	1.329E-07
U-234	2.455E+05	9.171E-03	9.170E-03	9.186E-03
U-235	7.038E+08	6.025E-05	6.025E-05	6.021E-05
U-236	2.342E+07	1.530E-04	1.530E-04	1.532E-04
U-238	4.470E+09	3.090E-06	3.090E-06	3.090E-06

Table E-7. (continued).

Nuclide	Half-life (y)	Best-estimate total activity computed from all disposal dates (Ci)	Best-estimate total activity decay corrected to the year 2000 (Ci)	Wenzel's data reported for the year 2000[a] (Ci)
Np-237	2.144E+06	9.000E-04	9.000E-04	8.984E-04
Pu-238	8.770E+01	1.181E+01	9.809E+00	9.791E+00
Pu-239	2.411E+04	1.797E-01	1.796E-01	1.784E-01
Pu-240	6.563E+03	1.432E-01	1.429E-01	1.425E-01
Pu-241	1.435E+01	2.566E+01	8.042E+00	8.073E+00
Pu-242	3.733E+05	2.922E-04	2.922E-04	2.943E-04
Pu-244	8.080E+07	4.409E-12	4.409E-12	4.406E-12
Am-241	4.322E+02	7.581E-01	7.286E-01	7.556E-01
Am-243	7.370E+03	1.914E-03	1.910E-03	1.916E-03
Cm-243	2.910E+01	3.103E-04	1.646E-04	—
Cm-244	1.810E+01	1.907E-02	6.947E-03	—
Cm-245	8.500E+03	1.724E-06	1.720E-06	—
Cm-246	4.760E+03	1.369E-07	1.364E-07	—
Cm-247	1.560E+07	1.769E-13	1.769E-13	—
Cm-248	3.480E+05	2.148E-13	2.147E-13	—
Subtotal =		7.283E+03	3.852E+03	3.850E+03[a]

a. Obtained from Attachment T of Wenzel (2000a). Note: The reported subtotal value shown here is less than the value reported in Attachment T because fewer radionuclides are included in this table.

E-4. REFERENCES

LMITCO, 1995, *A Comprehensive Inventory of Radiological and Nonradiological Contaminants in Waste Buried in the Subsurface Disposal Area of the INEL RWMC During the Years 1952–1983*, Vol. 1, INEL-95/0310, Rev. 1, Idaho National Engineering and Environmental Laboratory.

Wenzel, D. R., 2000a, "Assessment of the Radionuclide Activities in WCF Filters Shipped to the RWMC between 1964 and 1981," INTEC-2000-001/1642,September 25, 2000.

Wenzel, D. R., 2000b, "Determination of the Normalized Mass of Individual Radionuclides in the Dissolver Product for Aluminum, Zirconium and Stainless Steel Fuels Previously Processed at INTEC," INTEC-2000-006, February 8, 2000.