APPENDIX D – NUCLEAR REGULATORY COMMISSION CORRESPONDENCE

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Tennessee Valley Authority, Post Office Box 1010, Muscle Shoals, Alabama 35660

September 5, 1995

Ms. Diane Heim
Materials Licensing Section
Nuclear Regulatory Commission
101 Marietta Street, NW
Atlanta, Georgia 30323

Dear Ms. Heim:

DESCRIPTION OF A LOW-LEVEL RADIOACTIVE MATERIAL BURIAL SITE ON THE TENNESSEE VALLEY AUTHORITY RESERVATION IN MUSCLE SHOALS, ALABAMA

From 1966 to 1981, the Tennessee Valley Authority operated a burial site for low-level radioactive wastes on the TVA Reservation in Muscle Shoals, Alabama. The burial site was authorized by license number 01-06113-02, issued by the Atomic Energy Commission. We have decided pursuant to 10 CFR 30.36 that we no longer intend to use this site for the burial of low-level radioactive materials.

Enclosed is a report on the site and its contents. In compliance with 10 CFR 30.36(d), we are developing a decommissioning plan for this burial site that will be submitted to you as soon as possible.

If you have any questions regarding this matter, please write me or call David Sorrelle at (205) 386-3515.

Sincerely,

Ronald J. Williams

Ronald J. Williams, Acting Manager
Environmental Research Center

Enclosure

A LOW-LEVEL RADIOACTIVE WASTE BURIAL SITE ON THE TENNESSEE VALLEY AUTHORITY (TVA) RESERVATION IN MUSCLE SHOALS, ALABAMA

DESCRIPTION OF THE BURIAL SITE

This low-level radioactive waste burial site is located in the southwest corner of the TVA Reservation in Colbert County, Muscle Shoals, Alabama. It is about 120 feet from the southwest corner of the rhizotron-lysimeter building on a magnetic bearing of 228 degrees. The facility is surrounded by a 10-foot chain-link fence topped with barbed wire. The facility is about 100 feet long and 100 feet wide. Its location is shown in figure 1.

Forty-two holes were dug at the burial site. Each hole was dug by an auger 2 feet in diameter to a depth of 10 feet. The holes were filled with waste to a depth of 6 feet and capped with 4 feet of clay. Two of the holes (holes No. 41 and 42) were not used and were completely filled with nonradiological cover material. Thus, the waste was buried in 40 holes. Each hole is marked with a metal pole with a numbered metal tag attached. Over the years, the waste has compacted slightly and some of the fill material on some of the holes has subsided. Additional soil cover material has been added when necessary to maintain the level of the tops of the filled-in holes. Typical hole subsidence has never exceeded a few inches.

The holes were dug in five rows. The locations of the holes in the burial site are shown in figure 2. The holes in the first three rows (holes 1 through 30) have a spacing of about 7 feet between the holes and from the fence. The spacing of the holes in the next two rows is somewhat greater with only nine holes (numbers 31 through 39) in the fourth row. Only three holes were dug in the fifth row, and only one (hole No. 40) was used to store radioactive material.

The surface soil is classified as a Decatur clay loam. The thickness of this clay in the area of the burial site is 50 to 75 feet (Harris, Moore and West Geology and Ground-Water Resources of Colbert County, 1960). Wells dug by TVA within 1 mile of the site show the clay to be relatively uniform to a depth of 50 feet. Groundwater usage in the shallow 50- to 75-foot aquifer has largely been curtailed because of industrial pollution and urban runoff into sink holes.

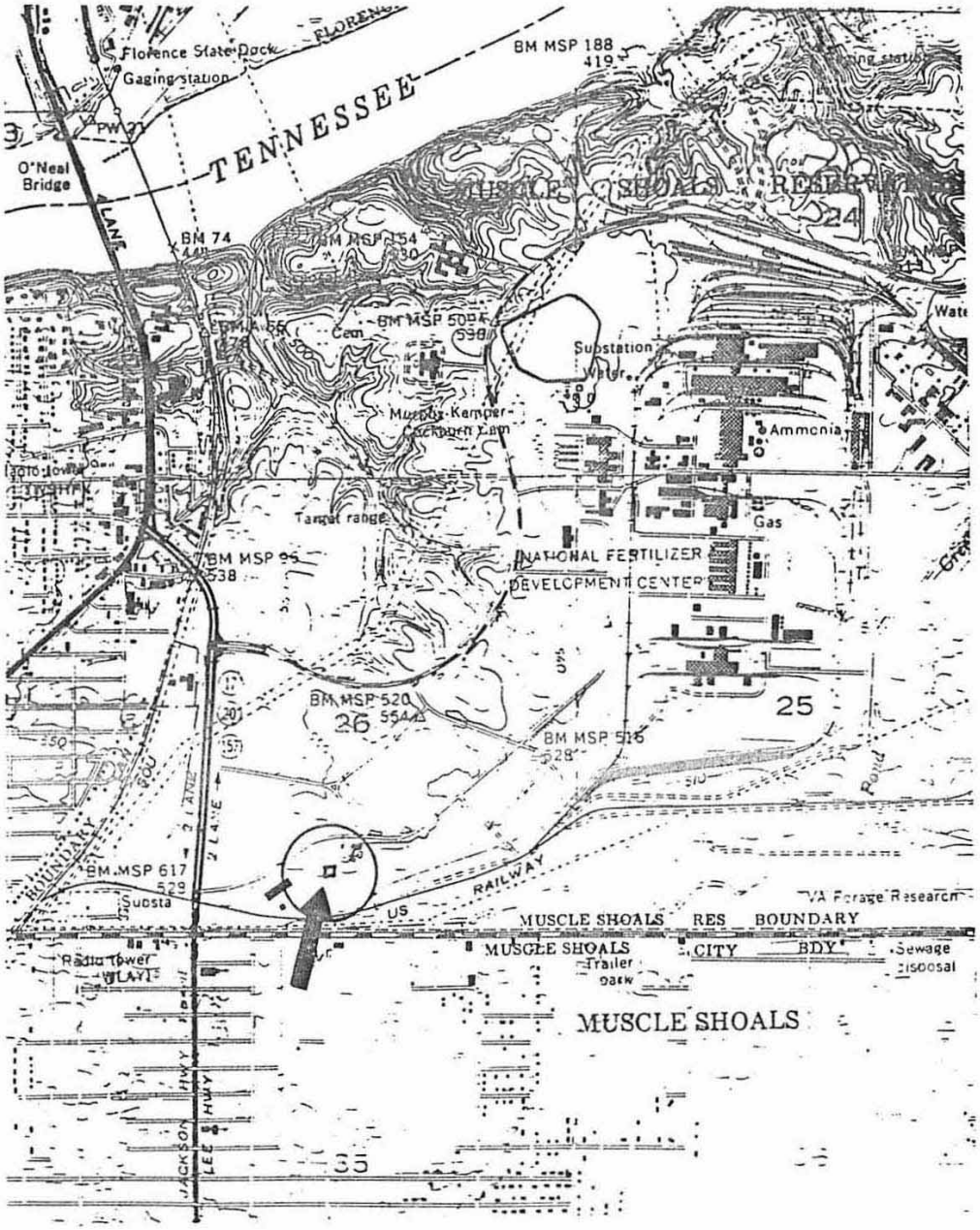

Figure 1. Location of the Inactive, Low-Level Radioactive Waste Burial Site on the TVA Reservation in Muscle shoals, AL

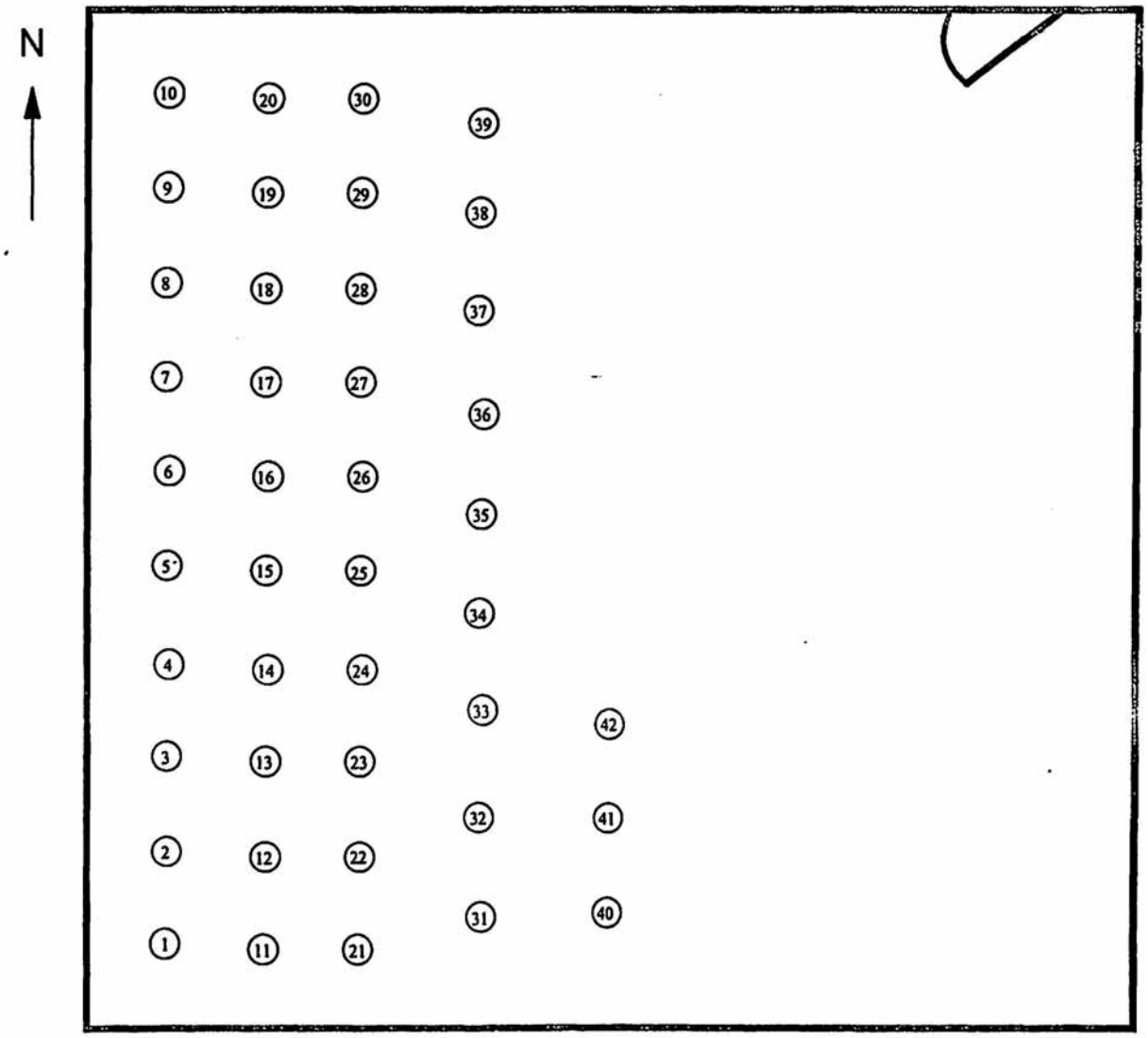

Figure 2
Location of the Holes in the Inactive Low-Level Radioactive Waste Burial Site

This soil has a cation exchange capacity of 10 to 15 me/100 gm. This is a measure of the mass of clay that is required to capture an ionic material through a natural cation exchange process. An "me" is a milliequivalent. One equivalent of an ionic material is defined as the gram atomic weight of the ion divided by the valence of the ion. Calculations indicate that most radionuclides in the burial site were captured in a very small mass of clay and migrated no more than a few inches from their initial location.

HISTORY OF THE BURIAL SITE

Licensing: This burial site was approved by the Atomic Energy Commission by-product license No. 01-06113-02, dated July 15, 1964, and issued to TVA's Office of Agricultural and Chemical Development. This by-product license was renewed several times until 1992 when it was merged with several other licenses into license No. 01-06113-03. The operation of low-level radioactive material burial sites was allowed under 10 CFR 20.304. This rule was deleted effective January 29, 1981. After that time, disposal of low-level radioactive wastes was accomplished by other means as authorized by the Nuclear Regulatory Commission.

Burials of low-level radioactive wastes occurred on this site from April 1966 to January 1981. The material buried in this site was waste generated by several licenses issued to different organizations within TVA. Records indicate that no material from non-TVA licensees and no material from TVA's nuclear power plants was buried at this site. The material was primarily wastes from agricultural experiments and laboratories located in the Muscle Shoals area.

Records indicate that all of the material buried at this site was classified as by-product materials except for a small quantity of enriched uranium that was classified as special nuclear material. The records indicate that less than 20 grams of uranium were buried. Hole number 34 contains 9.167 grams of U-238 + U-235 and 0.1857 grams of U-235. Hole number 39 contains 7.96 grams of U-238 and 0.15 grams of U-235. This material appears to be waste material from quality control checks of nonirradiated fuel pellets with enrichments of a nominal 3 percent or less. This material was possessed under a special nuclear material license that was terminated in the 1980s.

NONRADIOLOGICAL ASPECTS OF THE BURIED MATERIAL

Surviving records describe the radiological content of the disposals in detail. However, the physical and chemical aspects of the disposals were usually not described. Records indicate the following: Less than 4 gallons of xylene-based liquid scintillation cocktail was buried. The xylene-contained activity in the picocurie and microcurie range with most isotopes having short half-lives. The xylene is contained in 50-ml high-density plastic vials. The major volume of material buried was contaminated laboratory waste consisting of such things as gloves and paper towels. Contaminated soil from greenhouse experiments was also buried.

The records do not indicate that any lead was ever placed in this burial site. The presence of lead in the burial site is unlikely. Lead would have been needed only to shield intense gamma ray sources and such sources were not buried in this site.

RADIOLOGICAL ASPECTS OF THE BURIED MATERIAL

The activity of each radionuclide placed in each hole was entered into a computer spreadsheet, and the activity was decay corrected to August 1995. These detailed data are listed in appendix 3.

In order to summarize the radionuclides that remain in the burial site, the radioisotopes were divided into two classes depending on their half-lives.

The initial quantities of radionuclides with short half-lives are listed in appendix 2. The radionuclide with the longest half-life in this group is Cd-109 with a half-life of 1.27 yr. Appendix 2 indicates that a total of 1642 µCi of Cd-109 was buried in the site. During the 15 years the site has been closed, this material has undergone at least 12 half-lives, so that less than a quarter of a µCi of this radionuclide remains. We regard all of the short-lived material listed in appendix 2 as decayed away and of little significance.

Appendix 1 lists the quantity of all long-lived radioactive materials in each hole. These quantities were decay corrected to August 1995.

The tables in appendices 1 and 2 provide the sums of all activities in each hole and also the sums of activities for each radionuclide summed over all holes.

Listed below is the total of each of the long-lived radionuclides that remain in the burial site. These quantities are decay corrected to August 1995.

Isotope	Quantity (µCi)	Isotope	Quantity (µCi)
H-3	30	Eu-152	40.8
C-14	16301	Bi-207	8.44
Na-22	0.000074	Po-208	0.00012
Cl-36	1.22	Pb-210	0.745
K-40	0.308	Ra-226	1.89
Co-60	18.6	Ra-228	0.000052
Sr-90	65.6	Th-230	0.78
Sb-125	0.374	U-235	0.105
Ba-133	0.605	U-238	3.47
Cs-134	0.097	U-Natural	3.58
Cs-137	39.2	Am-241	14.3

APPENDIX 1

ACTIVITY OF LONG-LIVED RADIOISOTOPES AS OF AUGUST 1995

Activity of Long Lived Radioisotopes as of August 1995 (micro Ci)

Isotope:		H-3	C-14	Na-22	Cl-36	K-40	Co-60
Half Life (yr.):		12.35	5730	2.602	3.01E+05	1.28E+09	5.271
Hole No.	Date Closed						
1	April 1966	0	0	0	0	0	0
2	Feb. 1967	0	0	0	0	0	0
3	Oct. 1967	0	0	0	0	0	0
4	Oct. 1967	0	0	0	0	0	0
5	May 1968	0	0	0	0	0	0
6	Oct. 1968	0	0	0	0	0	0.000765
7	Mar. 1969	0	0	0	0	0	0
8	Aug. 1969	0	0	0	0	0	0
9	Feb. 1970	0	0	0	0	0	0.00106
10	Feb. 1970	0.024	0.1	0	0	0	0.000707
11	Aug. 1970	0.0247	0.1	0	0	0	0.00755
12	Feb. 1971	0.0508	0.1	0	0	0	0.0806
13	Nov. 1971	0	0.2	0	0	0	1.11
14	April 1972	0.0572	0.1	0	0	0	0.951
15	Feb. 1973	0.0568	5000	0	0	0	0.262
16	April 1974	0.0607	0	0	0	0	0.00367
17	July 1975	0.0651	10000	0	0	0	0.00144
18	Jan. 1976	0	0	0	0	0	0
19	Jan. 1976	0.0067	0	0	0	0	0.00231
20	Aug. 1976	0	0	0	0	0	0
21	Aug. 1976	0.344	0	0	0	0	2.47
22	Oct. 1976	0	0	0	0	0	0
23	Oct. 1976	0.00349	0	0	0	0	0.017
24	Feb. 1977	0.00356	0.1	0	0.01	0	0.000888
25	Aug. 1977	0.331	1000	0	0.01	0	0.0422
26	Dec. 1977	16.5	0.001	0	0	0.008	0.0516
27	May 1978	0	0	0	0	0	0
28	March 197	0.189	0	0	0	0	0.0144
29	June 1978	0.383	0	0	1.2	0	0.127
30	Oct. 1978	0	0	0	0	0	0
31	Jan. 1979	1.58	86	0	0	0	0.491
32	Nov. 1978	0.000392	0	0	0	0	0.702
33	Jan. 1979	0.000396	0	0	0	0	0.0891
34	Aug. 1979	2.31	14.1	0	0	0.3	2.05
35	Nov. 1979	0.125	0	0	0	0	0.319
36	Nov. 1979	0	0	0	0	0	0
37	June 1980	16.8	100.08	0	0	0	0.307
38	June 1980	0.0858	0	0	0	0	0.0044
39	Jan. 1981	0.0137	100.4	0	0	0	8.97
40	Jan. 1981	0.0239	0	0.000074	0	0.0001	0.542
Totals by Isotope:		39.03924	16301.28	0.000074	1.22	0.3081	18.61869

Activity of Long Lived Radioisotopes as of August 1995 (micro Ci), Continued

Isotope:	Sr-90	Sb-125	Ba-133	Cs-134	Cs-137	Eu-152
Half Life (yr.):	29.12	2.77	10.74	2.062	30	13.33
Hole No.						
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0.0658	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0.00546	0	0	0	0	0
10	0.0546	0	0	0	0.0111	0
11	0.0553	0	0	0	0	0
12	0.224	0	0	0	0.0114	0
13	0.342	0	0	0	0.232	0
14	0.236	0	0	0.000041	0.123	0
15	0.0117	0	0	0.000053	0.119	0
16	0.0603	0	0	0	0.0918	0
17	0.0621	0	0	0.00012	0.063	0
18	0	0	0	0	0	0
19	0.0189	0	0.00284	0.00005	0.0191	0
20	0	0	0	0	0	0
21	0	0	0	0	3.22	0
22	0	0	0	0	0	0
23	0	0	0	0.00732	0.00648	0
24	0	0	0	0.00002	6.6	0.768
25	0.0195	0	0	0.00262	1.056	9.81
26	0.0658	0	0	0.00006	0.554	0
27	0	0	0	0	0	0
28	0	0	0	5.9E-06	0.0415	0
29	0.000666	0	0	0.0468	2.7	20.6
30	0	0	0	0	0	0
31	0.00675	0	0	0.000039	1.5	0
32	0.000673	0	0	0	3.51	0
33	0.000675	0	0	0	0.13	0
34	3.3	0	0	0.0353	13.6	0
35	0	0	0	0.0017	0.195	0
36	0	0	0	0	0	0
37	0.00307	0	0.567	0.00261	0.882	9.67
38	65.1	0	0	0	0.0212	0
39	0.000708	0	0	0	3.3	0
40	0.0029	0.374	0.0353	0.000489	1.16	0
Totals by Isotope:	69.5711	0.374	0.60514	0.097228	39.21238	40.848

Activity of Long Lived Radioisotopes as of August 1995 (micro Ci), Continued

Isotope:	Bi-207	Po-208	Pb-210	Ra-226	Ra-228	Th-230
Half Life (yr.):	38	2.896	22.3	1600	5.75	7.7E+04
Hole No.						
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	0	0	0	0	0	0
13	0	0	0	0	0	0
14	0	0	0	0	0	0
15	0	0	0	0	0	0
16	0	0	0	0.1	0	0
17	0	0	0	0	0	0
18	0	0	0	0	0	0
19	0	0	0	0	0	0
20	0	0	0	0	0	0
21	0	0	0	0.01	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0	0	0	0.01	0	0
25	0	0	0.743	0.002	0	0.002
26	0	0.000022	0	0.0016	0	0.02
27	0	0	0	0	0	0
28	0	0.000016	0	0.005	0	0.01
29	0	0.000017	0	0.005	0	0.01
30	0	0	0	0	0	0
31	0	0	0	0.1	0	0.1
32	0	0	0	0.075	0	0.075
33	0	0	0	1.08	0	0.08
34	0	2.4E-06	0	0.16	0	0.16
35	0	0	0	0.08	0	0.08
36	0	0	0	0	0	0
37	0	0	0	0.17	0	0.16
38	0	0	0	0.08	0	0.08
39	0	0.000034	0.00127	0.002	0	0.002
40	8.44	0.000031	0.000637	0.011	0.000052	0.001
Totals by Isotope:	8.44	0.000122	0.744907	1.8916	0.000052	0.78

Activity of Long Lived Radioisotopes as of August 1995 (micro Ci), Continued

Isotope:	U-235	U-238	U-Nat.	Am-241	Total per Hole (micro Ci)
Half Life (yr.):	7.0E+08	4.468E+09	4.468E+09	432.2	
Hole No.					
1	0	0	0	0	0
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	0	0	0	0.066565
7	0	0	0	0	0
8	0	0	0	0	0
9	0	0	0	0	0.00652
10	0	0	0	0	0.190407
11	0	0	0	0	0.18755
12	0	0	0	0	0.4668
13	0	0	0	0	1.884
14	0	0	0	0	1.467241
15	0	0	0	0	5000.45
16	0	0	0	0	0.31647
17	0	0	0	0	10000.19
18	0	0	0	0	0
19	0	0	0	0	0.0499
20	0	0	0	0	0
21	0	1	0	1	8.044
22	0	0	0	0	0
23	0	0	0	0	0.03429
24	0	0	0	0.01	7.502468
25	0	0	0.002	0	1012.02
26	0	0	0	0	17.20208
27	0	0	0	0	0
28	0	0	0	0	0.259922
29	0	0	0	0	25.07248
30	0	0	0	0	0
31	0.1	0	0	0	89.87779
32	0	0	0.075	0.003	4.441065
33	0	0.081	0	0	1.461171
34	0	0	3.18	10.001	49.1963
35	0	0	0.08	0	0.8807
36	0	0	0	0	0
37	0	0.00005	0.16	0.004	128.8057
38	0	0	0.08	0	65.4514
39	0.0045	2.388	0.002	0.009	115.0932
40	0	0	0.0022	3.31	13.90368
Totals by Isotope:	0.1045	3.46905	3.5812	14.337	16544.52

APPENDIX 2

INITIAL ACTIVITY OF SHORT-LIVED RADIOISOTOPES

Initial Activity of Short Lived Radioisotopes (micro Ci.)

Isotope:		Be-7	P-32	P-33	S-35	Ca-45	Cr-51
Half Life(yr):		0.146	0.039	0.070	0.239	0.446	0.076
Half Lives in 15 yr:		103	385	214	63	34	197
Hole No.	Date Closed						
1	April 1966	0	500	0	0	0	0
2	Feb. 1967	0	1500	0	20000	0	0
3	Oct. 1967	0	9400	0	0	0	0
4	Oct. 1967	0	4000	0	0	0	0
5	May 1968	0	5000	0	0	0	0
6	Oct. 1968	0	0	0	0	0	0
7	Mar. 1969	0	1000	0	0	0	0
8	Aug. 1969	0	1000	0	0	0	0
9	Feb. 1970	0	0	0	0	0	0
10	Feb. 1970	0	0.01	0	0	0.03	0
11	Aug. 1970	0	0	0	0	0	0
12	Feb. 1971	0	0	0	0	0	0
13	Nov. 1971	0	0	0	0	0	0
14	April 1972	0	1000.2	0	500	0	0.1
15	Feb. 1973	0	1000	0	1000	0	0.1
16	April 1974	0	0	0	0	0	0
17	July 1975	0	500	10	500	0	0
18	Jan. 1976	0	1500		500	0	0
19	Jan. 1976	0	0	0	0	0	0.02
20	Aug. 1976	0	500	0	0	0	0
21	Aug. 1976	0	1000	0	0	0	0.01
22	Oct. 1976	0	4000	0	1000	0	0
23	Oct. 1976	0	0	0	0	0	0.01
24	Feb. 1977	0	0.02	0	0	0	0.1
25	Aug. 1977	0.202	4000.02	0	0	0	0.06
26	Dec. 1977	0.05	0.06	0	1	0	0.304
27	May 1978	0	0	0	1300	0	0
28	March 197	0.012	0	0	0	0	0.007
29	June 1978	0	2100	0	0	0	1.4
30	Oct. 1978	0	0	0	7490	0	0
31	Jan. 1979	0.2	500	0	200	0	0
32	Nov. 1978	0	0	0	0	0	0
33	Jan. 1979	0	0	0	0	0	0
34	Aug. 1979	0.072	1000.552	0	501	0	0.02
35	Nov. 1979	0.23	0.02	0	5000	0	0.03
36	Nov. 1979	0	0	0	4500	0	0
37	June 1980	0.0001	1500	0	18.001	0	0.006
38	June 1980	0	0.001	0	0	0	0
39	Jan. 1981	0	500.002	250	0	0	0
40	Jan. 1981	0.0013	0.04	0	0	0	0.017
Totals by Isotope:		0.7674	41500.93	260	42510	0.03	2.184

Initial Activity of Short Lived Radioisotopes (micro Ci.), Continued

Isotope:	Mn-54	Co-57	Co-58	Fe-59	Zn-65	SE-75
Half Life(yr):	0.856	0.742	0.194	0.122	0.668	0.328
Half Lives in 15 yr:	18	20	77	123	22	46
Hole No.						
1	0	0	0	0	12000	0
2	150	0	0	0	7100	0
3	200	0	0	0	200	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0.0743	0	0	0	0.0748	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0.01	0	0	0	0.01	0
11	0	0	0	0	0	0
12	0.2	0	0	0	0.1	0
13	0	0	0	0	0	0
14	0.2	0	0	0	0.1	0
15	0.2	0	0	0	0.1	0
16	0.0025	0	0	0	0.001	0
17	0	0	0.1	0	0.01	0
18	0	0	0	0	1000	0
19	0.11	0	0	0	0	0
20	0	0	0	0	1000	0
21	1	0	0.1	0.5	0.01	0
22	0	0	0	0	0	0
23	0	0	0	0	0.04	0
24	0.01	0	0.2	0	0.01	0
25	0.021	0.12	0.011	0	0.621	0.8
26	0.021	1.71	0.9	0.5	0.015	0
27	0	0	0	0	0	0
28	0.001	0.022	0.009	0	0.001	0
29	1.5	0.04	0	0	0.12	0
30	0	0	0	0	0	0
31	0.01	0	0	0.1	0.03	0
32	0	0.026	0.002	0	0	0
33	0	0.032	0	0	0	0
34	0.782	0.074	0	0	0.484	0.05
35	0	0.3	0.04	0.2	0.1	0
36	0	0	0	0	0	0
37	0.405	0.18	0.005	0	0.323	0
38	0.001	0.006	0	0.011	0.001	0
39	0.0001	4.273	0	0.08	0.0001	0
40	0.0065	0.59	0.051	0.091	0.0054	0
Totals by Isotope:	354.5544	7.373	1.418	1.482	21302.16	0.85

Initial Activity of Short Lived Radioisotopes (micro Ci.), Continued

Isotope:	Sr-85	Sr-89	Y-88	Zr-95	Mo-99	Ru-103
Half Life(yr):	0.177	0.138	0.292	0.278	0.007	0.107
Half Lives in 15 yr:	85	109	51	54	2143	140
Hole No.						
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0.023	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0.03	0	0.01
11	0	0	0	0	0	0
12	0	0	0	0.1	0	0
13	0	0	0	0	0	0
14	0	0	0	0.11	0	0
15	0	0	0	0.1	0	0
16	0	0	0	0	0	0
17	0	0	0	0.1	0	0
18	0	0	0	0	0	0
19	0	0	0	0.04	0	0
20	0	0	0	0	0	0
21	0	0	0	0.1	0	0
22	0	0	0	0	0	0
23	0	0	0	0	0	0
24	0.02	0.2	0	0	0	0
25	0.304	0.1	3.5	0.023	0.02	0
26	0.021	0.03	0.32	3	0	0
27	0	0	0	0	0	0
28	0.02	0	0.202	0	0	0
29	0	0.11	0.005	0.4	0	0
30	0	0	0	0	0	0
31	0	0.2	1.5	0	0	0
32	0.005	0.001	0.09	0	0	0
33	0.053	0.001	0.121	0.1	0	0
34	0.167	0.241	0.37	0	0.0001	0
35	0.03	0	0.13	0	0	0
36	0	0	0	0	0	0
37	0.356	0.003	1.04	0.002	0	0
38	0.013	0.15	0.028	0	0	0
39	0.058	0.001	0.175	0	0	0
40	0.039	0.091	0.245	0.000064	0	0
Totals by Isotope:	1.086	1.128	7.726	4.128064	0.0201	0.01

Initial Activity of Short Lived Radioisotopes (micro Ci.), Continued

Isotope:	Ru-106	Cd-109	Ag-110m	Sn-113	I-131	Ce-139
Half Life(yr):	1.010	1.270	0.684	0.315	0.022	0.377
Half Lives in 15 yr:	15	12	22	48	682	40
Hole No.						
1	0	0	0	0	0	0
2	0	0	0	0	0	0
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0.256	0	0	0	0.09	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0.01	0
10	0.3	0	0	0	0.01	0
11	0	0	0	0	0	0
12	0.2	0	0	0	0.01	0
13	0	0	0	0	0.2	0
14	0.2	0	0	0	0.02	0
15	0.1	0	0	0	0.01	0
16	0.1	0	0	0	0	0
17	0.1	0	0	0	0.1	0
18	0	0	0	0	0	0
19	0.03	0	0	0	0.011	0
20	0	1000	0	0	0	0
21	0.01	0.01	0	0	0.01	0
22	0	500	0	0	0	0
23	0	0.1	0	0	0.01	0
24	0.01	0	0	0	0.11	0
25	0.01	33.01	0	0.32	3.22	0.115
26	0.011	3.45	0	0.11	0.28	0.11
27	0	0	0	0	0	0
28	0	0.37	0	0.042	1.001	0.015
29	4.8	0.7	0	0	0.2	0
30	0	0	0	0	0	0
31	0	20.21	0	0	1.3	0
32	0	0.7	0	0.09	0.008	0.008
33	0	0.8	0	0.06	0.2	0.02
34	11.03	2.2	2.4	0.197	1.6	0.06
35	0.22	1	0	0.061	0.48	0.21
36	0	0	0	0	0	0
37	0.017	41.5	0	0.463	0.402	0.15
38	0	0.13	0	0.017	0.34	0.005
39	0	33.56	0	0.095	0.134	0.035
40	0.722	4.28	0	0.084	0.1	0.07
Totals by Isotope:	18.116	1642.02	2.4	1.539	9.856	0.798

Initial Activity of Short Lived Radioisotopes (micro Ci.), Continued

Isotope:	Ce-141	Ba-140	Ce-144	Au-195	Hg-203	Po-210	Totals
Half Life(yr):	0.089	0.035	0.778	0.501	0.128	0.379	By Hole:
Half Lives in 15 yr:	169	429	19	30	117	40	
Hole No.							
1	0	0	0	0	0	0	12500
2	0	0	0	0	0	0	28750
3	0	0	0	0	0	0	9800
4	0	0	0	0	0	0	4000
5	0	0	0	0	0	0	5000
6	0	0.0123	0.063	0	0	0	0.5934
7	0	0	0	0	0	0	1000
8	0	0	0	0	0	0	1000
9	0	0	0	0	0	0	0.01
10	0	0.01	0.03	0	0	0	0.45
11	0	0	0	0	0	0	0
12	0	0.01	0.2	0	0	0	0.82
13	0	0.2	0	0	0	0	0.4
14	0	0.01	0.2	0	0	0	1501.14
15	0	0.01	0.2	0	0	0	2000.82
16	0	0	0.1	0	0	0	0.2035
17	0	0	0.1	0	0	0	1010.51
18	0	0	0	0	0	0	3000
19	0	0.011	0.08	0	0	0	0.302
20	0	0	0	0	0	0	2500
21	0	0.01	0.01	0	0	0	1001.77
22	0	0	0	0	0	0	5500
23	0	0	0	0	0	0	0.16
24	0	0.11	0.01	0	0.02	0	0.82
25	0	0.111	0.033	0	0.301	0	4042.922
26	0	0	0.232	0	0.011	0.001	12.136
27	0	0	0	0	0	0	1300
28	0	0	0.0013	0	2.006	0	3.7093
29	0.02	0	0.001	0	0	0	2109.296
30	0	0	0	0	0	0	7490
31	0	0.1	0	0	0	0	723.65
32	0	0.007	0	0	0.008	0	0.945
33	0.02	0.05	0.19	0	0.024	0	1.671
34	0	0	2.42	0	0.0891	0	1523.808
35	0	0	0	0.002	0.006	0	5003.059
36	0	0	0	0	0	0	4500
37	0	0.003	2.106	0	0.166	0.0001	1565.128
38	0	0.01	0.0001	0	0.006	0	0.7191
39	0	0	0.031	0	0.023	0.001	788.4682
40	0.008	2.0E-06	0.025	0	0.0075	0.000243	6.474009
Totals by Isotope:	0.048	0.664302	6.0324	0.002	2.6676	0.002343	107640

APPENDIX 3

DETAILED LISTING OF ALL RADIOISOTOPES IN EACH HOLE, INCLUDING INITIAL ACTIVITIES AND ACTIVITIES DECAY CORRECTED TO AUGUST 1995

Hole No.: 1
Date filled: April 1966
Decay Time to Aug '95: 29.25 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
P-32	500	0.039124	747.6	<E-99
Zn-65	12000	0.667762	43.8	7.8E-10

Hole No.: 2
Date filled: March 1967
Decay Time to Aug '95: 28.42 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
P-32	1500	0.039124	726.3	<E-99
S-35	20000	0.239398	118.7	3.7E-32
Mn-54	150	0.855578	33.2	1.5E-08
Zn-65	7100	0.667762	42.6	1.1E-09

Hole No.: 3
Date filled: Oct. 1967
Decay Time to Aug '95: 27.83 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
P-32	9400	0.039124	711.4	<E-99
Mn-54	200	0.855578	32.5	3.2E-08
Zn-65	200	0.667762	41.7	5.7E-11

Hole No.: 4
Date filled: Oct. 1967
Decay Time to Aug '95: 27.83 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
P-32	4000	0.039124	711.4	<E-99

Hole No.: 5
Date filled: May 1968
Decay Time to Aug '95: 27.17 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
P-32	5000	0.039124	694.4	<E-99

Hole No.: 6
Date filled: Oct. 1968
Decay Time to Aug '95: 26.75 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
Mn-54	0.0743	0.855578	31.3	2.9E-11
Co-60	0.0258	5.271	5.1	0.000765
Zn-65	0.0748	0.667762	40.1	6.5E-14
Zr-Nb-95	0.0230	0.27826	96.1	2.6E-31
Ru-Rh-106	0.2560	1.008077	26.5	2.6E-09
I-131	0.0900	0.022012	1215.2	<E-99
Cs-137	0.1220	30	0.9	0.065757
Ba-La-140	0.0123	0.03488	766.9	<E-99
Ce-Pr-144	0.0630	0.778371	34.4	2.8E-12

Hole No.: 7
Date filled: Mar. 1969
Decay Time to Aug '95: 26.33 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
P-32	1000	0.039124	673.1	<E-99

Hole No.: 8
Date filled: Aug. 1969
Decay Time to Aug '95: 25.92 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
P-32	1000	0.039124	662.4	<E-99

Hole No.: 9
Date filled: Feb. 1970
Decay Time to Aug '95: 25.42 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
Co-60	0.03	5.271	4.8	0.001061
Sr-Y-90	0.01	29.12	0.9	0.005461
I-131	0.01	0.022012	1154.7	<E-99

Hole No.: 10
Date filled: Feb. 1970
Decay Time to Aug '95: 25.42 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.10	12.35	2.1	0.024014
C-14	0.10	5730	0.0	0.099693
P-32	0.01	0.039124	649.6	<E-99
Ca-45	0.03	0.44627	57.0	2.1E-19
Mn-54	0.01	0.855578	29.7	1.1E-11
Co-60	0.02	5.271	4.8	0.000707
Zn-65	0.01	0.667762	38.1	3.5E-14
Sr-Y-90	0.10	29.12	0.9	0.054608
Zr-Nb-95	0.03	0.27826	91.3	9.6E-30
Ru-103	0.01	0.107543	236.3	7.2E-74
Ru-106	0.30	1.008077	25.2	7.7E-09
I-131	0.01	0.022012	1154.7	<E-99
Cs-137	0.02	30	0.8	0.011117
Ba-La-140	0.01	0.03488	728.7	<E-99
Ce-Pr-144	0.03	0.778371	32.7	4.4E-12

Hole No.: 11
Date filled: Aug. 1970
Decay Time to Aug '95: 24.92 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.1	12.35	2.0	0.024698
C-14	0.1	5730	0.0	0.099699
Co-60	0.2	5.271	4.7	0.007551
Sr-Y-90	0.1	29.12	0.9	0.055261

Hole No.: 12
Date filled: Feb. 1971
Decay Time to Aug '95: 24.42 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.2	12.35	2.0	0.050801
C-14	0.1	5730	0.0	0.099705
Mn-54	0.2	0.855578	28.5	5.1E-10
Co-60	2	5.271	4.6	0.080645
Zn-65	0.1	0.667762	36.6	9.8E-13
Sr-Y-90	0.4	29.12	0.8	0.223692
Zr-Nb-95	0.1	0.27826	87.7	3.8E-28
Ru-106	0.2	1.008077	24.2	1.0E-08
I-131	0.01	0.022012	1109.2	<E-99
Cs-137	0.2	30	0.8	0.113769
Ba-La-140	0.01	0.03488	700.0	<E-99-
Ce-Pr-144	0.2	0.778371	31.4	7.2E-11

Hole No.: 13
Date filled: Nov. 1971
Decay Time to Aug '95: 23.67 yr.

Isotope	Initial Activity (micro Ci)			Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
	Transfer 1	Transfer 2	Total			
C-14	0.1	0.1	0.2	5730	0.0	0.199428
Co-60	15	10	25	5.271	4.5	1.112557
Sr-Y-90	0.4	0.2	0.6	29.12	0.8	0.341582
I-131	0.1	0.1	0.2	0.022012	1075.2	<E-99
Cs-137	0.3	0.1	0.4	30	0.8	0.231516
Ba-La-140	0.1	0.1	0.2	0.03488	678.5	<E-99

Hole No.: 14
Date filled: June 1972
Decay Time to Aug '95: 23.17 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Transfer 3	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.2	0	0.01	0.21	12.35	1.9	0.057218
C-14	0.1	0	0	0.10	5730	0.0	0.09972
P-32	0.2	1000	0	1000.20	0.039124	592.1	<E-99
S-35	0	500	0	500.00	0.239398	96.8	3.7E-27
Cr-51	0.1	0	0	0.10	0.075849	305.4	1.1E-93
Mn-54	0.2	0	0	0.20	0.855578	27.1	1.4E-09
Co-60	10	0	10	20.00	5.271	4.4	0.950534
Zn-65	0.1	0	0	0.10	0.667762	34.7	3.6E-12
Sr-Y-90	0.4	0	0.01	0.41	29.12	0.8	0.236209
Zr-Nb-95	0.1	0	0.01	0.11	0.27826	83.3	9.5E-27
Ru-106	0.2	0	0	0.20	1.008077	23.0	2.4E-08
I-131	0.01	0	0.01	0.02	0.022012	1052.4	<E-99
Cs-134	0.1	0	0	0.10	2.062	11.2	0.000041
Cs-137	0.2	0	0.01	0.21	30	0.8	0.122958
Ba-La-140	0.01	0	0	0.01	0.03488	664.2	<E-99
Ce-Pr-144	0.2	0	0	0.20	0.778371	29.8	2.2E-10

Hole No.: 17
Date filled: July 1975
Decay Time to Aug '95: 20.00 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.2	0	0.2	12.35	1.6	0.065093
C-14	0	10000	10000	5730	0.0	9975.836
P-32	0	500	500	0.039124	511.2	<E-99
P-33	0	10	10	0.069541	287.6	2.7E-86
S-35	0	500	500	0.239398	83.5	3.5E-23
Co-58	0.1	0	0.1	0.19384	103.2	8.7E-33
Co-60	0.02	0	0.02	5.271	3.8	0.001442
Zn-65	0.01	0	0.01	0.667762	30.0	9.6E-12
Sr-Y-90	0.1	0	0.1	29.12	0.7	0.062122
Zr-Nb-95	0.1	0	0.1	0.27826	71.9	2.3E-23
Ru-106	0.1	0	0.1	1.008077	19.8	1.1E-07
I-131	0.1	0	0.1	0.022012	908.6	<E-99
Cs-134	0.1	0	0.1	2.062	9.7	0.00012
Cs-137	0.1	0	0.1	30	0.7	0.062996
Ce-144	0.1	0	0.1	0.778371	25.7	1.8E-09

Hole No.: 18
Date filled: Jan. 1976
Decay Time to Aug '95: 19.50 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
P-32	1500	0.039124	498.4	<E-99
S-35	500	0.239398	81.5	1.5E-22
Zn-65	1000	0.667762	29.2	1.6E-06

Hole No.: 19
Date filled: Jan. 1976
Decay Time to Aug '95: 19.50 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.01	0.01	0.02	12.35	1.6	0.006695
Cr-51	0.01	0.01	0.02	0.075849	257.1	8.1E-80
Mn-54	0.1	0.01	0.11	0.855578	22.8	1.5E-08
Co-60	0.01	0.02	0.03	5.271	3.7	0.002309
Sr-Y-90	0.02	0.01	0.03	29.12	0.7	0.01886
Zr-Nb-95	0.02	0.02	0.04	0.27826	70.1	3.2E-23
Ru-106	0.01	0.02	0.03	1.008077	19.3	4.5E-08
I-131	0.01	0.001	0.011	0.022012	885.9	<E-99
Ba-133	0.01	0	0.01	10.74	1.8	0.002841
Cs-134	0.015	0.02	0.035	2.062	9.5	0.00005
Cs-137	0.01	0.02	0.03	30	0.7	0.019118
Ba-140	0.01	0.001	0.011	0.03488	559.1	<E-99
Ce-144	0.06	0.02	0.08	0.778371	25.1	2.3E-09

Hole No.: 20
Date filled: Aug.1976
Decay Time to Aug '95: 19.00 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
P-32	500	0.039124	485.6	<E-99
Zn-65	1000	0.667762	28.5	2.7E-06
Cd-109	1000	1.270363	15.0	0.031455

Hole No.: 21
Date filled: Aug.1976
Decay Time to Aug '95: 19.00 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	1	0	1	12.35	1.5	0.344252
P-32	0	1000	1000	0.039124	485.6	<E-99
Cr-51	0.01	0	0.01	0.075849	250.5	3.9E-78
Mn-54	1	0	1	0.855578	22.2	2.1E-07
Co-58	0.1	0	0.1	0.19384	98.0	3.1E-31
Fe-59	0.5	0	0.5	0.121914	155.8	6.1E-48
Co-60	30	0	30	5.271	3.6	2.466152
Zn-65	0.1	1000	1000.1	0.667762	28.5	2.7E-06
Sr-85	0.01	0	0.01	0.177522	107.0	6.0E-35
Zr-Nb-95	0.1	0	0.1	0.27826	68.3	2.8E-22
Ru-106	0.01	0	0.01	1.008077	18.8	2.1E-08
Cd-109	0.01	0	0.01	1.270363	15.0	3.1E-07
I-131	0.01	0	0.01	0.022012	863.2	<E-99
Cs-137	5	0	5	30	0.6	3.223426
Ba-140	0.01	0	0.01	0.03488	544.7	<E-99
Ce-144	0.01	0	0.01	0.778371	24.4	4.5E-10
Ra-226	0.01	0	0.01	1600	0.0	0.009918
U-238	1	0	1	4.468E+09	0.0	1
Am-241	1	0	1	432.2	0.0	0.969988

Hole No.: 22
Date filled: Oct. 1976
Decay Time to Aug '95: 18.75 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
P-32	4000	0.039124	479.2	<E-99
S-35	1000	0.667762	28.1	3.5E-06
Cd-109	500	1.270363	14.8	0.018026

Hole No.: 23
Date filled: Oct. 1976
Decay Time to Aug '95: 18.75 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.01	12.35	1.5	0.003491
Cr-51	0.01	0.075849	247.2	3.8E-77
Co-60	0.2	5.271	3.6	0.016991
Zn-65	0.04	0.667762	28.1	1.4E-10
Cd-109	0.1	1.27036	14.8	3.6E-06
I-131	0.01	0.022012	851.8	<E-99
Cs-134	4	2.062	9.1	0.007324
Cs-137	0.01	30	0.6	0.006484

Hole No.: 24
Date filled: Feb. 1977
Decay Time to Aug '95: 18.42 yr.

Isotope	Initial Activity (micro Ci)			Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
	Transfer 1	Transfer 2	Total			
H-3	0	0.01	0.01	12.35	1.5	0.003557
C-14	0	0.1	0.1	5730	0.0	0.099777
P-32	0.01	0.01	0.02	0.039124	470.7	<E-99
Cl-36	0.01	0	0.01	3.01E+05	0.0	0.01
Cr-51	0	0.1	0.1	0.075849	242.8	8.1E-75
Mn-54	0	0.01	0.01	0.855578	21.5	3.3E-09
Co-58	0.1	0.1	0.2	0.19384	95.0	5.0E-30
Co-60	0	0.01	0.01	5.271	3.5	0.000888
Zn-65	0	0.01	0.01	0.667762	27.6	5.0E-11
Sr-85	0.01	0.01	0.02	0.177522	103.7	1.2E-33
Sr-89	0.1	0.1	0.2	0.138261	133.2	1.6E-41
Ru-106	0	0.01	0.01	1.008077	18.3	3.2E-08
I-131	0.01	0.1	0.11	0.022012	836.7	<E-99
Cs-134	0	0.01	0.01	2.062	8.9	0.00002
Cs-137	0.1	10	10.1	30	0.6	6.599673
Ba-140	0.01	0.1	0.11	0.03488	528.0	<E-99
Ce-144	0	0.01	0.01	0.778371	23.7	7.5E-10
Eu-152	0	2	2	13.33	1.4	0.767588
Hg-203	0.01	0.01	0.02	0.127584	144.3	7.0E-46
Ra-226	0	0.01	0.01	1600	0.0	0.009921
Am-241	0.01	0	0.01	432.2	0.0	0.009709

Hole No.: 25
Date filled: Aug. 1977
Decay Time to Aug '95: 18.00 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Transfer 3	Transfer 4	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.01	0.5	0.4	0	0.91	12.35	1.5	0.331355
Be-7	0.2	0	0.002	0	0.202	0.145927	123.3	1.5E-38
C-14	0	0	0	1000	1000	5730	0.0	997.8249
P-32	0	0	0.02	4000	4000.02	0.039124	460.1	<E-99
Cl-36	0	0.01	0	0	0.01	3.01E+05	0.0	0.01
Cr-51	0.01	0	0.05	0	0.06	0.075849	237.3	2.2E-73
Mn-54	0.01	0.01	0.001	0	0.021	0.855578	21.0	9.8E-09
Co-57	0	0.1	0.02	0	0.12	0.741684	24.3	5.9E-09
Co-58	0.01	0	0.001	0	0.011	0.19384	92.9	1.2E-30
Co-60	0.05	0.2	0.2	0	0.45	5.271	3.4	0.042191
Zn-65	0.01	0.6	0.011	0	0.621	0.667762	27.0	4.8E-09
Se-75	0	0	0.8	0	0.8	0.327995	54.9	2.4E-17
Sr-85	0	0.3	0.004	0	0.304	0.177522	101.4	9.1E-32
Sr-89	0.1	0	0	0	0.1	0.138261	130.2	6.4E-41
Sr-90	0	0	0.03	0	0.03	29.12	0.6	0.019545
Y-88	0	1.2	2.3	0	3.5	0.291964	61.7	9.7E-19
Zr-Nb-95	0.01	0.01	0.002	0	0.022	0.175168	102.8	2.6E-33
Mo-99	0	0.02	0	0	0.02	0.007529	2390.7	<E-99
Ru-106	0.01	0	0	0	0.01	1.008077	17.9	4.2E-08
Cd-109	0.01	2	31	0	33.01	1.270363	14.2	0.001792
Sn-113	0	0.3	0.02	0	0.32	0.315127	57.1	2.0E-18
I-131	1	1.2	1.02	0	3.22	0.022012	817.7	<E-99
Cs-134	1.1	0.01	0.001	0	1.111	2.062	8.7	0.002618
Cs-137	0.1	1.3	0.2	0	1.6	30	0.6	1.055606
Ce-139	0	0.08	0.035	0	0.115	0.376893	47.8	4.8E-16
Ba-140	0.1	0.01	0.001	0	0.111	0.03488	516.1	<E-99
Ce-144	0.01	0.02	0.003	0	0.033	0.778371	23.1	3.6E-09
Eu-152	5	0	20	0	25	13.33	1.4	9.805007
Hg-203	0	0.3	0.001	0	0.301	0.127584	141.1	1.0E-43
Pb-210	0	1.3	0	0	1.3	22.3	0.8	0.74295
Ra-226	0	0	0.002	0	0.002	1600	0.0	0.001984
Th-230	0	0	0.002	0	0.002	7.7E+04	0.0	0.002
U-238-235	0	0	0.002	0	0.002	4.468E+09	0.0	0.002

Hole No.: 26
Date filled: Dec. 1977
Decay Time to Aug '95: 17.58 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.3	44.1	44.4	12.35	1.4	16.54973
Be-7	0.03	0.02	0.05	0.145927	120.5	2.7E-38
C-14	0.001	0	0.001	5730	0.0	0.000998
P-32	0.06	0	0.06	0.039124	449.4	<E-99
S-35	0	1	1	0.239562	73.4	8.0E-23
K-40	0	0.008	0.008	1.28E+09	0.0	0.008
Cr-51	0.3	0.004	0.304	0.075849	231.8	5.0E-71
Mn-54	0	0.021	0.021	0.855578	20.6	1.4E-08
Co-57	0	1.71	1.71	0.741684	23.7	1.2E-07
Co-58	0	0.9	0.9	0.19384	90.7	4.4E-28
Co-60	0	0.521	0.521	5.271	3.3	0.051599
Fe-59	0.5	0	0.5	0.121997	144.1	2.1E-44
Zn-65	0	0.015	0.015	0.667762	26.3	1.8E-10
Sr-85	0	0.021	0.021	0.177522	99.0	3.2E-32
Sr-89	0	0.03	0.03	0.138261	127.2	1.6E-40
Sr-90	0	0.1	0.1	29.12	0.6	0.065801
Y-88	0	0.32	0.32	0.291964	60.2	2.4E-19
Y-90	0	0.1	0.1	0.007306	2406.7	<E-99
Zr-95	0	2	2	0.175168	100.4	1.2E-30
Nb-95	0	3	3	0.096301	182.6	3.3E-55
Ru-106	0	0.011	0.011	1.008077	17.4	6.2E-08
d-109	0	3.45	3.45	1.270363	13.8	0.000235
Sn-113	0	0.11	0.11	0.315127	55.8	1.8E-18
I-131	0.07	0.21	0.28	0.022012	798.8	<E-99
Ba-133	0.02	0.1	0.12	10.74	1.6	0.038578
Cs-134	0	0.022	0.022	2.062	8.5	0.00006
Cs-137	0.001	0.831	0.832	30	0.6	0.554225
Ce-139	0	0.11	0.11	0.376893	46.7	9.9E-16
Ce-144	0	0.232	0.232	0.778371	22.6	3.7E-08
Hg-203	0	0.011	0.011	0.127584	137.8	3.6E-44
Po-208	0.001	0.0005	0.0015	2.896	6.1	0.000022
Po-210	0.001	0	0.001	0.379123	46.4	1.1E-17
Ra-226	0.001	0.0006	0.0016	1600	0.0	0.001588
Th-230	0.01	0.01	0.02	7.7E+04	0.0	0.019997

Hole No.: 27
Date filled: May 1978
Decay Time to Aug '95: 17.17 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
S-35	600	700	1300	0.239562	71.7	3.5E-19

Hole No.: 28
Date filled: March 1978
Decay Time to Aug '95: 17.33 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.5	12.35	1.4	0.189004
Be-7	0.012	0.145927	118.8	2.1E-38
Cr-51	0.007	0.075849	228.5	1.1E-71
Mn-54	0.001	0.855578	20.3	8.0E-10
Co-57	0.022	0.741684	23.4	2.0E-09
Co-58	0.009	0.19384	89.4	1.1E-29
Co-60	0.141	5.271	3.3	0.014431
Zn-65	0.001	0.667762	26.0	1.5E-11
Sr-85	0.02	0.177522	97.6	8.1E-32
Y-88	0.202	0.291964	59.4	2.7E-19
Cd-109	0.37	1.270363	13.6	0.000029
Sn-113	0.042	0.315127	55.0	1.2E-18
I-131	1.001	0.022012	787.4	<E-99
Cs-134	0.002	2.062	8.4	5.9E-06
Cs-137	0.062	30	0.6	0.04154
Ce-139	0.015	0.376893	46.0	2.1E-16
Ce-144	0.0013	0.778371	22.3	2.6E-10
Hg-203	2.006	0.127584	135.9	2.5E-41
Po-208	0.001	2.896	6.0	0.000016
Ra-226	0.005	1600	0.0	0.004963
Th-230	0.01	7.7E+04	0.0	0.009998

Hole No.: 29
Date filled: June, 1978
Decay Time to Aug '95: 17.08 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	1	0	1	12.35	1.4	0.38335
P-32	0	2100	2100	0.039124	436.6	<E-99
Cl-36	1.2	0	1.2	3.01E+05	0.0	1.199953
Cr-51	1.4	0	1.4	0.075849	225.2	2.2E-68
Mn-54	1.5	0	1.5	0.855578	20.0	1.5E-06
Co-57	0.04	0	0.04	0.741684	23.0	4.7E-09
Co-60	1.2	0	1.2	5.271	3.2	0.126923
Zn-65	0.12	0	0.12	0.667762	25.6	2.4E-09
Sr-89	0.11	0	0.11	0.138261	123.6	7.0E-39
Sr-90	0.001	0	0.001	29.12	0.6	0.000666
Y-88	0.005	0	0.005	0.291964	58.5	1.2E-20
Zr-Nb-95	0.4	0	0.4	0.175168	97.5	1.8E-30
Ru-106	4.8	0	4.8	1.008077	16.9	0.000038
Cd-109	0.7	0	0.7	1.270363	13.4	0.000063
I-131	0.2	0	0.2	0.022012	776.1	<E-99
Cs-134	14.6	0	14.6	2.062	8.3	0.046813
Cs-137	4	0	4	30	0.6	2.695505
Ce-141	0.02	0	0.02	0.089041	191.9	3.5E-60
Ce-144	0.001	0	0.001	0.778371	21.9	2.5E-10
Eu-152	50	0	50	13.33	1.3	20.56738
Po-208	0.001	0	0.001	2.896	5.9	0.000017
Ra-226	0.005	0	0.005	1600	0.0	0.004963
Th-230	0.01	0	0.01	7.7E+04	0.0	0.009998

Hole No.: 30
Date filled: Oct. 1978
Decay Time to Aug '95: 16.75 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
S-35	7490	0.239562	69.9	6.7E-18

Hole No.: 31
Date filled: Jan. 1979
Decay Time to Aug '95: 16.50 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Transfer 3	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	4	0	0	4	12.35	1.3	1.584434
Be-7	0.2	0	0	0.2	0.145927	113.1	1.8E-35
C-14	0	0	86	86	5730	0.0	85.82852
P-32	0	500	0	500	0.039124	421.7	<E-99
S-35	0	200	0	200	0.239562	68.9	3.7E-19
Mn-54	0.01	0	0	0.01	0.855578	19.3	1.6E-08
Co-60	4.3	0	0	4.3	5.271	3.1	0.49107
Fe-59	0.1	0	0	0.1	0.121997	135.2	1.9E-42
Zn-65	0.03	0	0	0.03	0.667762	24.7	1.1E-09
Sr-89	0.2	0	0	0.2	0.138261	119.3	2.4E-37
Sr-90	0.01	0	0	0.01	29.12	0.6	0.006752
Y-88	1.5	0	0	1.5	0.291964	56.5	1.5E-17
Cd-109	20.21	0	0	20.21	1.270363	13.0	0.002487
I-131	1.3	0	0	1.3	0.022012	749.6	<E-99
Ba-133	2	0	0	2	10.74	1.5	0.689531
Ba-140	0.1	0	0	0.1	0.034904	472.7	<E-99
La-140	0.1	0	0	0.1	0.004597	3589.3	<E-99
Cs-134	0.01	0	0	0.01	2.062	8.0	0.000039
Cs-137	2.2	0	0	2.2	30	0.6	1.502644
Ra-226	0.1	0	0	0.1	1600	0.0	0.099288
U-Natural	0.1	0	0	0.1	4.468E+09	0.0	0.1
Th-230	0.1	0	0	0.1	7.7E+04	0.0	0.099985

Hole No.: 32
Date filled: Nov. 1978
Decay Time to Aug '95: 16.67 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.001	12.35	1.3	0.000392
Co-57	0.026	0.741684	22.5	4.5E-09
Co-58	0.002	0.19384	86.0	2.6E-29
Co-60	6.28	5.271	3.2	0.701643
Sr-85	0.005	0.177522	93.9	2.7E-31
Sr-89	0.001	0.138261	120.5	5.2E-40
Sr-90	0.001	29.12	0.6	0.000673
Y-88	0.09	0.291964	57.1	5.9E-19
Cd-109	0.7	1.270363	13.1	0.000079
Sn-113	0.09	0.315127	52.9	1.1E-17
I-131	0.008	0.022012	757.2	<E-99
Ba-140	0.007	0.034904	477.5	<E-99
La-140	0.007	0.004597	3625.5	<E-99
Cs-137	5.16	30	0.6	3.510838
Ce-139	0.008	0.376893	44.2	3.9E-16
Hg-203	0.008	0.127584	130.6	3.8E-42
Ra-226	0.075	1600	0.0	0.07446
Th-230	0.075	7.7E+04	0.0	0.074989
U-Natural	0.075	4.468E+09	0.0	0.075
Am-241	0.003	432.2	0.0	0.002921

Hole No.: 33
Date filled: Jan. 1979
Decay Time to Aug '95: 16.50 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.001	12.35	1.3	0.000396
Co-57	0.032	0.741684	22.2	6.4E-09
Co-60	0.78	5.271	3.1	0.089078
Sr-85	0.053	0.177522	92.9	5.6E-30
Sr-89	0.001	0.138261	119.3	1.2E-39
Sr-90	0.001	29.12	0.6	0.000675
Y-88	0.121	0.291964	56.5	1.2E-18
Zr-Nb-95	0.1	0.183562	89.9	8.7E-29
Cd-109	0.8	1.270363	13.0	0.000098
Sn-113	0.06	0.315127	52.4	1.0E-17
I-131	0.2	0.022012	749.6	<E-99
Ba-133	3	10.74	1.5	1.034296
Ba-La-140	0.05	0.034904	472.7	<E-99
Cs-137	0.19	30	0.6	0.129774
Ce-139	0.02	0.376893	43.8	1.3E-15
Ce-141	0.02	0.089041	185.3	3.3E-58
Ce-144	0.19	0.778371	21.2	7.9E-08
Hg-203	0.024	0.127584	129.3	2.8E-41
Ra-226	1.08	1600	0.0	1.072308
Th-230	0.08	7.7E+04	0.0	0.079988
U-Natural	0.081	4.468E+09	0.0	0.081

Hole No.: 34
Date filled: Aug. 1979
Decay Time to Aug '95: 16.00 yr.

Isotope	Transfer 1	Transfer 2	Initial Activity (micro Ci) Transfer 3	Transfer 4	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.001	5.5	0.164	0	5.665	12.35	1.3	2.307818
Be-7	0	0	0.072	0	0.072	0.145927	109.6	7.1E-35
C-14	0	14.1	0	0	14.1	5730	0.0	14.07274
P-32	0	0.52	0.032	1000	1000.552	0.039124	409.0	<E-99
S-35	0	0	0	501	501	0.239562	66.8	3.9E-18
K-40	0	0	0.3	0	0.3	1.28E+09	0.0	0.3
Cr-51	0	0.02	0	0	0.02	0.075849	210.9	6.3E-66
Mn-54	0.65	0.02	0.112	0	0.782	0.855578	18.7	1.8E-06
Co-57	0.012	0.03	0.032	0	0.074	0.741684	21.6	2.4E-08
Co-60	5	2.7	9.074	0	16.774	5.271	3.0	2.045818
Zn-65	0.04	0.3	0.144	0	0.484	0.667762	24.0	3.0E-08
Se-75	0.05	0	0	0	0.05	0.328219	48.7	1.1E-16
Sr-85	0.02	0.13	0.017	0	0.167	0.177522	90.1	1.2E-28
Sr-89	0.001	0.12	0.12	0	0.241	0.138261	115.7	3.5E-36
Sr-90	0.02	0.003	4.8	0	4.823	29.12	0.5	3.295461
Y-88	0.06	0.21	0.1	0	0.37	0.291964	54.8	1.2E-17
Y-90	0.02	0	0	0	0.02	0.007306	2190.0	<E-99
Mo-99	0	0	0.0001	0	0.0001	0.007534	2123.6	<E-99
Ru-106	10	1	0.03	0	11.03	1.008077	15.9	0.000184
Cd-109	0.4	0.6	1.2	0	2.2	1.270363	12.6	0.000356
Ag-110m	2.4	0	0	0	2.4	0.684658	23.4	2.2E-07
Sn-113	0.032	0.11	0.055	0	0.197	0.315127	50.8	1.0E-16
I-131	0.6	0.7	0.3	0	1.6	0.022012	726.9	<E-99
Cs-134	0	0.02	7.631	0	7.651	2.062	7.8	0.035309
Cs-137	0.3	0.2	19.14	0	19.64	30	0.5	13.57038
Ce-139	0.01	0.03	0.02	0	0.06	0.376893	42.5	1.0E-14
Ce-144	0.9	0	1.52	0	2.42	0.778371	20.6	1.6E-06
Hg-203	0.006	0.08	0.0031	0	0.0891	0.127584	125.4	1.6E-39
Po-208	0	0	0.00011	0	0.00011	2.896	5.5	2.4E-06
Ra-226	0.08	0.08	0	0	0.16	1600	0.0	0.158895
Th-230	0.08	0.08	0	0	0.16	7.7E+04	0.0	0.159977
U-235	0	0	0	0.39	0.39	7.0E+08	0.0	0.39
U-Normal	0.1	0.08	0	3	3.18			
Am-241	0.05	0.001	9.95	0	10.001	432.2	0.0	9.747637

Transfer # 4 is a composite of 3 smaller transfers.

Hole No.: 35
Date filled: Nov. 1979
Decay Time to Aug '95: 15.67 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.3	0	0.3	12.35	1.3	0.124523
Be-7	0.23	0	0.23	0.145927	107.4	1.1E-33
P-32	0.02	0	0.02	0.039124	400.4	<E-99
S-35	0	5000	5000	0.239562	65.4	1.0E-16
Cr-51	0.03	0	0.03	0.075849	206.5	2.0E-64
Co-57	0.3	0	0.3	0.741684	21.1	1.3E-07
Co-58	0.04	0	0.04	0.19384	80.8	1.9E-26
Co-60	2.5	0	2.5	5.271	3.0	0.318572
Fe-59	0.2	0	0.2	0.121997	128.4	4.4E-40
Zn-65	0.1	0	0.1	0.667762	23.5	8.7E-09
Sr-85	0.03	0	0.03	0.177522	88.3	8.1E-29
Y-88	0.13	0	0.13	0.291964	53.7	9.1E-18
Ru-106	0.22	0	0.22	1.008077	15.5	4.6E-06
Cd-109	1	0	1	1.270363	12.3	0.000194
Sn-113	0.061	0	0.061	0.315127	49.7	6.6E-17
I-131	0.48	0	0.48	0.022012	711.7	<E-99
Cs-134	0.33	0	0.33	2.062	7.6	0.001704
Cs-137	0.28	0	0.28	30	0.5	0.194964
Ce-139	0.21	0	0.21	0.376893	41.6	6.4E-14
Au-195	0.002	0	0.002	0.501027	31.3	7.7E-13
Hg-203	0.006	0	0.006	0.127584	122.8	6.5E-40
Ra-226	0.08	0	0.08	1600	0.0	0.079459
Th-230	0.08	0	0.08	7.7E+04	0.0	0.079989
U-Normal	0.08	0	0.08			
Am-241	0.07	0	0.07	432.2	0.0	0.068263

Hole No.: 36
Date filled: Nov-1979
Decay Time to Aug '95: 15.67 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
S-35	4500	0.239562	65.4	9.3E-17

Hole No.: 37
Date filled: June 1980
Decay Time to Aug '95: 15.08 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Transfer 3	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	2	37.1	0	39.1	12.35	1.2	16.76957
Be-7	0.0001	0	0	0.0001	0.145927	103.4	7.7E-36
C-14	0.08	0	100	100.08	5730	0.0	99.89756
P-32	0	0	1500	1500	0.039124	385.5	<E-99
S-35	0	0.001	18	18.001	0.239562	63.0	2.0E-18
Mn-54	0.4	0.005	0	0.405	0.856164	17.6	2.0E-06
Cr-51	0	0.006	0	0.006	0.075849	198.9	8.2E-63
Co-57	0.14	0.04	0	0.18	0.741684	20.3	1.4E-07
Co-58	0	0.005	0	0.005	0.19384	77.8	1.9E-26
Co-60	0.83	1.4	0	2.23	5.271	2.9	0.306822
Zn-65	0.31	0.013	0	0.323	0.667762	22.6	5.1E-08
Sr-85	0.3	0.056	0	0.356	0.177522	85.0	9.4E-27
Sr-89	0	0.003	0	0.003	0.138356	109.0	4.6E-36
Sr-90	0.0004	0.004	0	0.0044	29.12	0.5	0.003073
Y-88	0.85	0.19	0	1.04	0.291964	51.7	2.9E-16
Y-90	0	0.004	0	0.004	0.007306	2064.5	<E-99
Zr-95	0	0.002	0	0.002	0.175288	86.0	2.5E-29
Nb-95	0	0.002	0	0.002	0.096301	156.6	1.4E-50
Ru-106	0.004	0.013	0	0.017	1.008077	15.0	5.3E-07
Cd-109	40.3	1.2	0	41.5	1.270363	11.9	0.011062
Sn-113	0.36	0.103	0	0.463	0.315127	47.9	1.8E-15
I-131	0.002	0.4	0	0.402	0.022012	685.2	<E-99
Ba-133	1.5	0	0	1.5	10.74	1.4	0.56666
Ba-140	0.003	0	0	0.003	0.034904	432.1	<E-99
Cs-134	0.41	0.006	0	0.416	2.062	7.3	0.002613
Cs-137	0.7	0.55	0	1.25	30	0.5	0.882183
Ce-139	0.11	0.04	0	0.15	0.376893	40.0	1.3E-13
Ce-144	2.1	0.006	0	2.106	0.778904	19.4	3.1E-06
Eu-152	21.2	0	0	21.2	13.33	1.1	9.676327
Hg-203	0.15	0.016	0	0.166	0.127584	118.2	4.3E-37
Po-210	0.0001	0	0	0.0001	0.379123	39.8	1.1E-16
Ra-226	0.09	0.08	0	0.17	1600	0.0	0.168893
U-238	0	0.00005	0	0.00005	4.468E+09	0.0	0.00005
Th-230	0.08	0.08	0	0.16	7.7E+04	0.0	0.159978
U-Normal	0.08	0.08	0	0.16			
Am-241	0.001	0.003	0	0.004	432.2	0.0	0.003904

Transfer 3 is a combination of 3 small transfers.

Hole No.: 38
Date filled: June 1980
Decay Time to Aug '95: 15.08 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.2	12.35	1.2	0.085778
P-32	0.001	0.039124	385.5	<E-99
Mn-54	0.001	0.856164	17.6	5.0E-09
Fe-59	0.011	0.121997	123.6	6.7E-40
Co-57	0.006	0.741684	20.3	4.5E-09
Co-60	0.032	5.271	2.9	0.004403
Zn-65	0.001	0.667762	22.6	1.6E-10
Sr-85	0.013	0.177522	85.0	3.4E-28
Sr-89	0.15	0.138356	109.0	2.3E-34
Sr-90	93.2	29.12	0.5	65.0865
Y-88	0.028	0.291964	51.7	7.9E-18
Cd-109	0.13	1.270363	11.9	0.000035
Sn-113	0.017	0.315127	47.9	6.6E-17
I-131	0.34	0.022012	685.2	<E-99
Ba-140	0.01	0.034904	432.1	<E-99
Cs-137	0.03	30	0.5	0.021172
Ce-139	0.005	0.376893	40.0	4.5E-15
Ce-144	0.0001	0.778904	19.4	1.5E-10
Hg-203	0.006	0.127584	118.2	1.5E-38
Ra-226	0.08	1600	0.0	0.079479
U-Normal	0.08			
Th-230	0.08	7.7E+04	0.0	0.079989

Hole No.: 39
Date filled: Jan. 1981
Decay Time to Aug '95: 14.5 yr.

Isotope	Initial Activity (micro Ci) Transfer 1	Transfer 2	Transfer 3	Total	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.031	0	0	0.031	12.35	1.2	0.013738
C-14	0.2	0.2	100	100.4	5730	0.0	100.224
P-32	0	0.0002	500	500.0002	0.039151	370.4	<E-99
P-33	0	0	250	250	0.069589	208.4	4.7E-61
Mn-54	0	0.0001	0	0.0001	0.856164	16.9	8.0E-10
Fe-59	0	0.08	0	0.08	0.121997	118.9	1.3E-37
Co-57	0.033	4.24	0	4.273	0.741684	19.6	5.6E-06
Co-60	0.259	60.12	0	60.379	5.271	2.8	8.969787
Zn-65	0	0.0001	0	0.0001	0.668219	21.7	2.9E-11
Sr-85	0.036	0.022	0	0.058	0.177522	81.7	1.5E-26
Sr-89	0	0.001	0	0.001	0.138356	104.8	2.8E-35
Sr-90	0	0.001	0	0.001	29.12	0.5	0.000708
Y-88	0.14	0.035	0	0.175	0.291964	49.7	2.0E-16
Cd-109	1.06	32.5	0	33.56	1.270363	11.4	0.012298
Sn-113	0.078	0.017	0	0.095	0.315127	46.0	1.3E-15
I-131	0.014	0.12	0	0.134	0.022012	658.7	<E-99
Cs-137	0.249	4.36	0	4.609	30	0.5	3.296924
Ce-139	0.03	0.005	0	0.035	0.376893	38.5	9.2E-14
Ce-144	0	0.031	0	0.031	0.778904	18.6	7.7E-08
Hg-203	0.009	0.014	0	0.023	0.127584	113.7	1.4E-36
Po-208	0.001	0.0011	0	0.0021	2.896	5.0	0.000065
Pb-210	0.001	0.001	0	0.002	22.3	0.7	0.001274
Po-210	0	0	0	0	0.379123	38.2	0
Ra-226	0.001	0.001	0	0.002	1600	0.0	0.001987
Th-230	0.001	0.001	0	0.002	7.7E+04	0.0	0.002
U-235	0	0	0.0045	0.0045	7.0E+08	0.0	0.0045
U-238	0	0	2.388	2.388	4.468E+09	0.0	2.388
U-Normal	0.001	0.001	0	0.002			
Am-241	0.006	0.003	0	0.009	432.2	0.0	0.008793

Transfer #3 was a combination of 4 small transfers.

Hole No.: 40
Date filled: Jan. 1981
Decay Time to Aug '95: 14.5 yr.

Isotope	Initial Activity (micro Ci)	Half Life (yr)	Number of Half Lives to Aug. '95	Activity Aug. 1995 (micro Ci)
H-3	0.054	12.35	1.2	0.023931
Be-7	0.0013	0.146027	99.3	1.7E-33
Na-22	0.0035	2.602	5.6	0.000074
P-32	0.04	0.039151	370.4	<E-99
K-40	0.0001	1.28E+09	0.0	0.0001
Cr-51	0.017	0.075901	191.0	5.3E-60
Mn-54	0.0065	0.856164	16.9	5.2E-08
Fe-59	0.091	0.121997	118.9	1.5E-37
Co-57	0.59	0.741684	19.6	7.7E-07
Co-58	0.051	0.193973	74.8	1.6E-24
Co-60	3.65	5.271	2.8	0.542237
Zn-65	0.0054	0.668219	21.7	1.6E-09
Sr-85	0.039	0.177522	81.7	1.0E-26
Sr-89	0.091	0.138356	104.8	2.6E-33
Sr-90	0.0041	29.12	0.5	0.002903
Y-88	0.245	0.291964	49.7	2.7E-16
Zr-Nb-95	0.000064	0.271589	53.4	5.4E-21
Ru-106	0.722	1.008767	14.4	0.000034
Cd-109	4.28	1.270363	11.4	0.001568
Sn-113	0.084	0.315127	46.0	1.2E-15
Sb-125	14.1	2.77	5.2	0.374481
I-131	0.1	0.022012	658.7	<E-99
Ba-133	0.09	10.74	1.4	0.035304
Ba-La-140	2.0E-06	0.039501	367.1	<E-99
Cs-134	0.064	2.062	7.0	0.000489
Cs-137	1.62	30	0.5	1.158823
Ce-139	0.07	0.376893	38.5	1.8E-13
Ce-141	0.008	0.089044	162.8	7.6E-52
Ce-144	0.025	0.778904	18.6	6.2E-08
Hg-203	0.0075	0.127584	113.7	4.6E-37
Bi-207	11	38	0.4	8.443567
Po-208	0.001	2,896	5.0	0.000031
Pb-210	0.001	22.3	0.7	0.000637
Po-210	0.000243	0.379123	38.2	7.5E-16
Ra-226	0.011	1600	0.0	0.010931
Ra-228	0.0003	5.75	2.5	0.000052
Th-230	0.001	7.7E+04	0.0	0.001
U- Normal	0.0022			
Am-241	3.31	432.2	0.0	3.233915

September 4, 1997

Ms. Dianne Heim
Materials Licensing Section
Nuclear Regulatory Commission
61 Forsyth Street SW, Suite 23T85
Atlanta, Georgia 30303

Dear Ms. Heim:

This is a decommissioning plan for the inactive low-level radioactive material burial site located on the Tennessee Valley Authority reservation in Muscle Shoals, Alabama. Burials of low-level radioactive materials were made at this site from 1966 to 1981 as authorized by the former 10 CFR 20.302 or 20.304. A detailed description of the contents of the burial site was transmitted to the NRC in a letter from TVA dated September 5, 1995. The low-level radioactive materials buried in this site were primarily wastes from fertilizer research and laboratory quality assurance tests.

This burial site contains isotopes with an atomic number greater than 88. Therefore, it fails screening tests 2 and 3 described in the NRC's "Branch Technical Position on Screening Methodology for Assessing Prior Land Burials of Radioactive Waste Authorized Under Former 10 CFR 20.304 and 20.302" (BTP), published in the Federal Register November 4, 1996. Because of the inability to use the screening methodologies described in the BTP, TVA performed a case-by-case evaluation of the burial site as instructed in the BTP. We used the RESRAD for Windows computer code Version 5.75, developed by the Environmental Assessment Division of the Argonne National Laboratory for the Department of Energy. The detailed listing of the radionuclides and their quantities buried in this site reported to NRC in the letter dated September 5, 1995, satisfies Step 1 (Records Review) of the BTP.

Of the 51 different radionuclides that TVA placed in the burial site, 27 are not analyzed by RESRAD. These are primarily short-lived isotopes. A conservative estimate of the maximum possible dose to an individual from these remaining materials is shown in Appendix A of the enclosed report. The analysis indicates that the 27 radionuclides would contribute much less than a mrem to any member of the public.

Ms. Dianne Heim
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September 4, 1997

The enclosed report describes the input parameters used for the RESRAD analysis and the hydrology and geology of the site. The report also includes the results of the computer analysis. Also attached is a report entitled NFERC Regional Groundwater Investigation, an extensive description of the hydrology and geology of the Muscle Shoals reservation. (NFERC stands for National Fertilizer and Environmental Research Center, a previous name for the Muscle Shoals reservation where this inactive burial site is located.)

According to computer analysis, the maximally exposed individual (MEI) would have received a total effective dose equivalent (TEDE) of 0.55 mrem during the year 1983. However, 92% of that calculated dose was from the drinking water pathway which assumes that drinking water is obtained from a well located in the center of or downgradient of the burial site. No wells are now nor have been located within 1,000 feet of the burial site, so the hypothetical dose was never delivered to any individual. Also, groundwater flow at the burial site is vertically downward. The maximum dose during 1997 is calculated to be only 2.5 E-6 mrem. RESRAD does not indicate any significant increase in this very low-dose rate at any time in the future. The low dose to the MEI is below the limits of both the BTP (100 mrem/yr) and 10 CRF 20, Subpart E (25 mrem/yr) published in the Federal Register on July 21, 1997.

ALARA considerations suggest that the removal of any remaining radioactive materials from the burial site should not be conducted. Such removal would be very expensive and would require considerable excavation to a depth of over 10 feet. The excavation would expose personnel to conventional safety hazards from the use of heavy equipment, excavation and transportation. These safety hazards to personnel removing and transporting the residual remaining material would probably exceed the minor hypothetical radiation risk to the public from the remaining radioactive materials.

Because of the low dose to the maximally exposed member of the public, TVA requests unrestricted access for this burial site.

If you have any questions regarding this matter, please contact Ms. Lenora Sheffey at (205) 386-3051.

David W. Sorrelle, Manager
Environmental Compliance
and Operations Support
Environmental Research Center

DWS:LCJ:HGG
Enclosures
cc: W. C. McArthur, BR 5D-C
Files, ERC, CEB 1B-M

AN ASSESSMENT OF THE ENVIRONMENTAL EFFECTS OF THE

INACTIVE LOW-LEVEL RADIOACTIVE MATERIAL BURIAL SITE

LOCATED ON THE MUSCLE SHOALS RESERVATION

MUSCLE SHOALS, ALABAMA

INTRODUCTION

From 1966 to 1981, the Tennessee Valley Authority (TVA) buried small quantities of low-level radioactive materials at a site on the TVA reservation located in Muscle Shoals, Alabama. These materials were wastes from fertilizer research and quality control programs in laboratories, primarily radioanalytical laboratories. Burials were authorized by the former 10 CFR 20.302 or 20.304. Regulations were terminated by the U.S. Nuclear Regulatory Commission (NRC) in January 1981. At that time, TVA ceased burials of low-level radioactive materials at the site.

Recently enacted NRC regulations require that the environmental impacts of this site be evaluated and a decommissioning plan provided. This report provides that evaluation and also describes the hydrology and geology of the region and of the burial site. The primary tool for evaluating the environmental impact of the site was the RESRAD computer code. This code, developed at Argonne National Laboratory, evaluates the radiation dose of the buried material to members of the public from the most conceivable environmental pathways.

A total of 51 different radionuclides were buried in this site. RESRAD was used to analyze the impact of 27 of them. However, 24 of the radionuclides that were buried in this site are not included in RESRAD, which are primarily short-lived radionuclides. A conservative estimate of the impact of these isotopes is given in Appendix A. Appendix B is a listing of the 27 isotopes that are analyzed by RESRAD. Appendix C is the printed output from RESRAD.

DESCRIPTION OF REGIONAL GEOLOGY:

The TVA reservation in Muscles Shoals, Alabama, is located in the Interior Low Plateau, a karst plateau lying on the southern flank of the Nashville Dome in northern Alabama. Erosion over a long period of time has stripped off the Pennsylvanian and younger Mississippian clastic rocks to expose Mississippian limestone formations throughout much of Tennessee, Alabama, and Kentucky. The reservation lies on the Mississippian limestone rocks which have a regional south-southwestern dip of 25 to 30 feet per mile.

The most relevant stratigraphic units underlying the inactive burial site are the Chattanooga Shale, the Fort Payne Chert, and the Tuscumbia Limestone. The Chattanooga Shale is an extensive regional marker and unconformably overlies the undifferentiated Ordovician and Silurian rocks. It does not crop out in the area, but well drilling suggests that it underlies the entire region with a thickness of 5 to 37 feet. It ranges from 250 to 450 feet below the surface in the reservation area and probably serves as a hydraulic barrier to groundwater. The Chattanooga Shale is overlain by the Mississippian Fort Payne Chert in the northern Alabama region.

The Fort Payne Chert underlies all of the area and crops out along the southern bluffs of the Tennessee River. It is a distinctive lithologic marker at the base of the Mississippian system of northern Alabama. The thickness of the Fort Payne Chert in the subsurface ranges from 162 to 210 feet. The Fort Payne Chert is conformably overlain by the Tuscumbia Limestone; the contact is gradational. However, in the weathered outcrops the nodular thin beds of the Fort Payne Chert contrast with massive limestone beds of Tuscumbia Limestone along the southern Bluffs of the Tennessee River.

The Tuscumbia Limestone underlies all of the region and is the uppermost bedrock unit in the reservation area. Exposures are common along the Tennessee River and along valleys of the larger tributaries. The thickness of the Tuscumbia Limestone ranges up to 200 feet; however, the formation has been extensively weathered in the area and its thickness remains as little as 50 feet in places. Throughout most of the area the Tuscumbia Limestone is overlain by a clayey overburden.

DESCRIPTION OR REGIONAL HYDROLOGY:

The north Alabama area has a mild, humid climate. Average precipitation is almost 52 inches per year (1.32 m/yr) with average monthly highs of 6.2 inches and lows of 2.8 inches in March and September, respectively. Precipitation is the source of all natural recharge into the groundwater system. Groundwater recharge occurs either very slowly through soil infiltration, or very rapidly by direct entry through storm-drainage wells or natural openings such as sinkholes. Recharge also occurs from surface streams and impoundments as well as other sources such as leaky sewer lines. Average recharge for the regional area has been estimated to be 13 inches per year. Twenty or more stormwater drainage wells have been constructed in the region and have been used for flood alleviation in the area during the last 35 years.

Although the area surrounding the ERC is flood prone due to inadequate drainage, the burial site is not located in a flood prone area. The Tuscumbia-Fort Payne aquifer system underlying the area is the most important water-bearing unit in the region because it is the source of water for both wells and springs in the area. Tuscumbia (Big) Spring is the closest public water supply. The spring issues from the Tuscumbia-Fort Payne aquifer system and is located about three miles southwest of the burial site. This spring serves as the drinking water supply for the city of Tuscumbia. The city of Sheffield takes its drinking water supply from the Tennessee River several miles downstream from the burial site. There are no known water supply wells within 1,000 feet of the burial site.

HYDROLOGY AND GEOLOGY OF THE BURIAL SITE:

The unsaturated soil layer varies in thickness throughout the year. A representative value of 50 feet (15.25 m), based on studies of near-by wells, was used for this analysis. The unsaturated layer and an additional 30-foot thick layer are composed of a residual silty, sandy, clay soil overburden. Under that layer lies a 200-foot thick layer of karstic cherty limestone. Groundwater flow is nearly vertically downward for a depth of approximately 280 feet where a anisotropic and heterogeneous karst aquifer is encountered. Dye tracer tests in the area indicate that this aquifer carries the majority of all groundwater horizontally to either the Tennessee River or to Tuscumbia Spring. Rapid solute migration accompanied by high dilution occurs in this bedrock. Dye velocities of 100 ft/day are commonly reported. Based on borehole flowmeter data, the majority of groundwater flow occurs near the overburden-bedrock contact across a 3-foot to 5-foot vertical interval. The transmissivity of this epikarst zone varies more than 4 orders of magnitude and may be greater than 500 ft^2/day.

This means that groundwater under the burial site flows slowly vertically downward for about 280 feet where it then flows rapidly horizontally and exits either in the Tennessee River (average flow is 32,800,000,000 gallons per day) where it is extensively diluted or to Tuscumbia Spring. Tuscumbia Spring has an average flow of 42,000,000 gallons per day with high seasonal variation.

Any radioactive materials reaching this spring from the burial site would be extensively diluted by this high flow and would present no hazard.

Dye studies indicate that material may flow either to the river or to the spring. To be conservative, we have assumed that groundwater is to Tuscumbia Spring which has an estimated recharge area of 84 square miles.

HYDROLOGICAL, GEOLOGICAL, AND OTHER INPUTS INTO RESRAD:

The following site-specific inputs to the RESRAD code were used:

Area of the contaminated zone:	308.5 m^2 (3,319 ft^2)
Thickness of the Contaminated Zone:	1.83 m (6 ft)
Length parallel to aquifer flow:	17.6 m (square root of 308.5 m^2)
Basic radiation dose limit:	10 mrem
Time since placement of material:	0 yr.
Times for calculations:	1, 5, 16, 40, 100, 300, 1000 yr
Cover depth:	1.22 m (4 ft)
Density of all soil and other materials:	1.5 g/cm^3
Contaminated zone total porosity:	0.4
Contaminated zone effective porosity:	0.06
Contaminated zone hydraulic conductivity:	0.3 m/yr
Contaminated zone b parameter:	7.75
Precipitation:	1.32 m
Watershed area for nearby stream or pond:	2.18 E+8 m^2 (84 sq mi)
Saturated zone total porosity:	0.3
Saturated zone effective porosity:	0.14
Saturated zone hydraulic conductivity:	53,400 m/yr
Saturated zone hydraulic gradient:	0.003
Water table drop rate:	0.0 m/yr
Unsaturated layer thickness	15.25 m (50 ft)
Unsaturated layer effective porosity	0.06
Unsaturated layer b parameter	10.4
Unsaturated layer hydraulic conductivity	0.3 m/yr

The initial concentrations of the 27 radionuclides in the burial site that were analyzed by RESRAD are listed in Appendix B.

Initial concentrations of radionuclides in groundwater was set to zero.

Default values were used for dose conversion factors, food transfer factors, bioaccumulation factors, distribution factors, dose shape factors, food consumption factors, contamination factors, all crop and livestock factors, all C-12 factors, and all building factors. The radon pathway was suppressed due to the small quantities of radon parents in the burial site.

The initial placement of all material was conservatively assumed to be 1981, the date the burial site was closed. This ignores the radiological decay that occurred from the time of actual burial to 1981. The date of 1981 corresponds to the year zero in the RESRAD run.

Any radioactive materials reaching this spring from the burial site would be extensively diluted by this high flow and would present no hazard.

Dye studies indicate that material may flow either to the river or to the spring. To be conservative, we have assumed that groundwater is to Tuscumbia Spring which has an estimated recharge area of 84 square miles.

HYDROLOGICAL, GEOLOGICAL, AND OTHER INPUTS INTO RESRAD:

The following site-specific inputs to the RESRAD code were used:

Area of the contaminated zone:	308.5 m^2 (3,319 ft^2)
Thickness of the Contaminated Zone:	1.83 m (6 ft)
Length parallel to aquifer flow:	17.6 m (square root of 308.5 m^2)
Basic radiation dose limit:	10 mrem
Time since placement of material:	0 yr.
Times for calculations:	1, 5, 16, 40, 100, 300, 1000 yr
Cover depth:	1.22 m (4 ft)
Density of all soil and other materials:	1.5 g/cm^3
Contaminated zone total porosity:	0.4
Contaminated zone effective porosity:	0.06
Contaminated zone hydraulic conductivity:	0.3 m/yr
Contaminated zone b parameter:	7.75
Precipitation:	1.32 m
Watershed area for nearby stream or pond:	2.18 E+8 m^2 (84 sq mi)
Saturated zone total porosity:	0.3
Saturated zone effective porosity:	0.14
Saturated zone hydraulic conductivity:	53,400 m/yr
Saturated zone hydraulic gradient:	0.003
Water table drop rate:	0.0 m/yr
Unsaturated layer thickness	15.25 m (50 ft)
Unsaturated layer effective porosity	0.06
Unsaturated layer b parameter	10.4
Unsaturated layer hydraulic conductivity	0.3 m/yr

The initial concentrations of the 27 radionuclides in the burial site that were analyzed by RESRAD are listed in Appendix B.

Initial concentrations of radionuclides in groundwater was set to zero.

Default values were used for dose conversion factors, food transfer factors, bioaccumulation factors, distribution factors, dose shape factors, food consumption factors, contamination factors, all crop and livestock factors, all C-12 factors, and all building factors. The radon pathway was suppressed due to the small quantities of radon parents in the burial site.

The initial placement of all material was conservatively assumed to be 1981, the date the burial site was closed. This ignores the radiological decay that occurred from the time of actual burial to 1981. The date of 1981 corresponds to the year zero in the RESRAD run.

APPENDIX A

Analysis of Buried Radionuclides Not Included in RESRAD

Of the 51 different radionuclides that were placed in TVA's inactive low-level burial site. 24 are not included in RESRAD. Thus, the computer model cannot estimate the dose to a member of the public from those 24 radionuclides. This appendix estimates the maximum possible dose to an individual that could result from the ingestion of all this material that remains in the burial site in 1997.

The 24 radionuclides are listed in Table A-1, with most of these radionuclides having rather short half-lives. Table A-1 lists the half-life of these isotopes and also the total activity that had been buried when the site was closed in 1981. The total activities listed in Table A-1 were taken from Appendices 2 and 3 of the report on the burial site submitted to the NRC in TVA's letter dated September 5, 1995. These total activities were assumed to have been buried in 1981, whereas they were actually buried at various times over a period of 15 years from 1966 to 1988 and had decayed to quantities lower than the total listed. These "total" activities were decayed for 16 years from 1981 to 1997. Table A-1 also lists the number of half-lives for each isotope for this 16-year period. With the exceptions of Ba-133 and Po-208, all radionuclides experienced from about 40 to several hundred half-lives and thus decayed to insignificant levels.

The ingestion Annual Limit on Intake (ALI) for each radionuclide is also listed in Table A-1. These ALIs were taken from Title 10 of the Code of Federal Regulations, Part 10, Appendix B, Table 1, Column 1 and from Federal Guidance Report 11 (EPA 1988). An ingestion ALI for Po-208 was not listed in either source. This ALI was conservatively estimated to be 2 μCi by a process described below.

In order to conservatively estimate the maximum environmental effect of the radionuclides remaining in the burial site and not included in RESRAD, we assume that all of this radioactive material that remained in 1997 was hypothetically gathered into a single small volume and was ingested by reference man in a single intake. The inhalation pathway is not considered credible for this hypothetical intake.

We now estimate the ingestion ALI for Po-208. The ingestion ALI for Po-208 is not listed in such standard references as Title 10 of the Code of Federal Regulations or Federal Guidance Report 10. For the purposes of this report, the ingestion ALI for Po-208 is estimated by considering the ALI for Po-210 and the properties of the radiations from Po-210 and Po-208. The ingestion ALI for Po-210 is 3 μCi (10CFR20). Po-210 is an alpha emitter with a maximum alpha energy of 5.3 MeV and a half-life of 138 days. Po-208 is an alpha emitter with a maximum energy of 5.1 MeV and a half-life of 2.9 years. All isotopes of polonium follow the same metabolic pathways in the body and have the same biological excretion rates from the same metabolic compartments. The biological half-lives for all isotopes of polonium in all systemic compartments is 50 days. Thus, the effective half-life for Po-210 in these compartments is 36.7 days and the effective half-life for Po-208 is 50 days. This means that Po-208 resides in systemic compartments about 33% longer, but has an alpha particle that is about 4% lower in energy. Thus, comparing unit intakes, Po-208 will be about 33% more hazardous than Po-210. Based on the ingestion ALI of 3 μCi for Po-210, we assign a value of 2 μCi to the ingestion ALI for Po-208.

Ingestion of one ALI results in an committed effective dose equivalent of 5,000 mrem. The hypothetical dose from the ingestion of each radionuclide in the burial site in 1997 was estimated by ratio. For example, 0.057 μCi of Ba-133 remains in the burial site and the ALI for this isotope is 2,000 μCi. The dose from the ingestion of 0.057 μCi of Ba-133 is (5,000 mrem)*(0.057 μCi)/ (2,000 μCi) = 1.4 mrem. As shown in Table A-1, only one other radionuclide had a calculated dose greater than 0.000 mrem. The estimated dose from the ingestion of the entire quantity of Po-208 remaining in the burial site is only 0.4 mrem. These doses are listed in Table A-1.

The hypothetical dose that would result from the ingestion of the entire quantity of all of these 24 radionuclides would be less than 2 mrem. It is important to notice that this is an extremely conservative overestimate of any actual dose that could result from these radioactive materials. The actual dose that a person may actually receive from these materials is expected to be several orders of magnitude lower that this value of 2 mrem, primarily from dilution in environmental media and the isolation of the materials in the environment.

APPENDIX B

Radionuclide Inputs into RESRAD

Of the 51 different radionuclides that were placed in the burial site, the environmental impact of 27 of them is analyzed by RESRAD. As input, RESRAD requires the activity per unit mass (pCi/g) for each radionuclide, averaged over the volume of soil in which the radioactive material was buried.

The material was buried in 40 holes, 2 feet in diameter, from 4 to 10 feet deep. Thus, the material is in a layer 6 feet (1.83m) thick. The area covered by the 40 holes, including the spaces between the holes, is 308.5 sq m. Thus, the volume occupied by the material is 5.65 E+8 cm^3. The density of the soil is 1.5 g/cm^3, thus, the mass of the soil in which the material is buried is 8.47 E+8 grams.

The activity of the 27 radionuclides that are analyzed by RESRAD as of August 1995 was taken from the report on the burial site submitted to the NRC in TVA's letter dated September 5, 1995. These 27 radionuclides are listed in Table B-1, along with their half-lives and their activities as of 1995.

RESRAD was run using 1981, the date the burial site was closed, as the starting time. Thus, the activities listed in Table B-1 were decay-corrected from 1995 to 1981. The decay factor for this 14-year period is greater than unity because we are calculating the activity 14 years in the past based on a known activity in 1995. The decay factors for each of the 27 radionuclides are also listed in Table B-1.

The left column in Table B-1 is the activity per unit mass in the burial site in 1981 and was used as input data for the RESRAD computer code. These activities per unit mass in 1981 were calculated by multiplying the activity in 1995 (pCi) by the decay factor and dividing by the mass of soil in which the material was buried.

Natural uranium was listed as being in the burial site in TVA's letter to the NRC dated September 5, 1995. That activity of U-natural was added to that of U-235 and U-238, which is proportional to the activity fraction of these two isotopes in natural uranium.

APPENDIX C

RESRAD Output

Table A1

Radionuclides in the Burial Site That are not Included in RESRAD

	Isotope	Half Life (yr)	Total Activity Buried (μCi)	Number of Half lives 1981 to 1997 (16 years)	Total Activity in 1997 (μCi)	Ingestion ALI (μCi)	Ingestion Dose (mrem)
1	Be-7	0.146	0.767	110	7.9E-34	4.E+04	0.000
2	P-32	0.039	41500	410	1.3E-119	6.E+02	0.000
3	P-33	0.070	260	229	4.1E-67	6.E+03	0.000
4	S-35	0.239	42510	67	3.0E-16	6.E+03	0.000
5	Ca-45	0.446	0.030	36	4.8E-13	2.E+03	0.000
6	Cr-51	0.076	2.180	211	9.2E-64	4.E+04	0.000
7	Co-58	0.194	1.420	82	2.1E-25	1.E+03	0.000
8	Fe-59	0.122	1.480	131	4.9E-40	8.E+02	0.000
9	Se-75	0.328	0.850	49	1.8E-15	5.E+02	0.000
10	Sr-85	0.177	1.090	90	6.7E-28	3.E+03	0.000
11	Sr-89	0.138	1.130	116	1.4E-35	5.E+02	0.000
12	Y-88	0.292	7.730	55	2.5E-16	1.E+03	0.000
13	Zr-95	0.175	4.130	91	1.2E-27	1.E+03	0.000
14	Mo-99	0.007	0.020	2286	0.0E+00	1.E+03	0.000
15	Ru-103	0.107	0.010	150	9.7E-48	2.E+03	0.000
16	Sn-113	0.315	1.540	51	7.9E-16	2.E+03	0.000
17	I-131	0.022	9.860	727	1.2E-218	3.E+01	0.000
18	Ce-139	0.377	0.800	42	1.3E-13	5.E+03	0.000
19	Ce-141	0.089	0.048	180	3.7E-56	2.E+03	0.000
20	Ba-133	10.740	1.600	1.5	5.7E-01	2.E+03	1.424
21	Ba-140	0.035	0.660	457	1.6E-138	5.E+02	0.000
22	Hg-203	0.128	2.670	125	6.3E-38	5.E+02	0.000
23	Po-208	2.896	0.0067	6	1.5E-04	2.E+00	0.364
24	Po-210	0.379	0.0023	42	4.6E-16	3.E+00	0.000
						Sum =	1.79

Table B 1

Concentration of Radionuclides in Burial site in 1981
For Radionuclides in RESRAD

		Activity in 1995 (μCi)	Activity in 1995 (pCi)	Half Life (yr)	Decay Factor for -14 years	Act/Mass of Soil in 1981 (pCi/g)
1	Ag-110m	2.2E-07	2.2E-01	0.684	1.4E+06	3.76E-04
2	Am-241	1.4E+01	1.4E+07	432.2	1.0E+00	1.73E-02
3	Au-195	8.0E-13	8.0E-07	0.501	2.6E+08	2.43E-07
4	Bi-207	8.4E+00	8.4E+06	38	1.3E+00	1.29E-02
5	C-14	1.6E+04	1.6E+10	5730	1.0E+00	1.93E+01
6	Cd-109	1.0E-01	1.0E+05	1.27	2.1E+03	2.45E-01
7	Ce-144	6.0E-06	6.0E+00	0.778	2.6E+05	1.85E-03
8	Cl-36	1.2E+00	1.2E+06	3.01E+05	1.0E+00	1.44E-03
9	Co-57	1.0E-05	1.0E+01	0.742	4.8E+05	5.63E-03
10	Co-60	1.9E+01	1.9E+07	5.27	6.3E+00	1.39E-01
11	Cs-134	9.7E-02	9.7E+04	2.062	1.1E+02	1.27E-02
12	Cs-137	3.9E+01	3.9E+07	30	1.4E+00	6.40E-02
13	Eu-152	4.1E+01	4.1E+07	13.33	2.1E+00	9.98E-02
14	H-3	3.9E+01	3.9E+07	12.35	2.2E+00	1.01E-01
15	K-40	3.1E-01	3.1E+05	1.28E+09	1.0E+00	3.64E-04
16	Mn-54	1.0E-05	1.0E+01	0.856	8.4E+04	9.88E-04
17	Na-22	7.4E-05	7.4E+01	2.602	4.2E+01	3.64E-06
18	Pb-210	7.5E-01	7.5E+05	22.3	1.5E+00	1.36E-03
19	Ra-226	1.9E+00	1.9E+06	1600	1.0E+00	2.25E-03
20	Ra-228	5.2E-05	5.2E+01	5.75	5.4E+00	3.32E-07
21	Ru-106	2.00E-04	2.0E+02	1.01	1.5E+04	3.51E-03
22	Sb-125	3.7E-01	3.7E+05	2.77	3.3E+01	1.47E-02
23	Sr-90	7.0E+01	7.0E+07	29.12	1.4E+00	1.15E-01
24	Th-230	7.8E-01	7.8E+05	7.70E+04	1.0E+00	9.21E-04
25	U-235	3.4E-03	3.4E+03	7.00E+08	1.0E+00	4.06E-06
26	U-238	4.3E-03	4.3E+03	4.47E+09	1.0E+00	5.02E-06
27	Zn-65	5.0E-06	5.0E+00	0.668	2.0E+06	1.20E-02

1.5 = Density of soil (g/ml)

308.5 = Surface area of burial site (sq m)
1.83 = Thickness of pits (m)

5.65E+02 = Volume of burial site (cu m)
5.65E+08 = Volume of burial site (cu cm)
8.47E+08 = Mass of soil (g)

NRC Contact
Jay Henson
404-562-4738

September 1, 1997
80 Valley View Dr.
Tuscumbia, Alabama 35674

Mr. David Sorrelle
CTR 2S
Tennessee Valley Authority
Muscle Shoals, Alabama

Dear Mr. Sorrelle:

Enclosed is a draft letter to the Nuclear Regulatory Commission (NRC). The letter includes a report on the environmental impact of the inactive low-level radioactive material burial site on the Muscle shoals reservation. Because of the low dose to the maximally exposed individual from the material remaining in this site, TVA is requesting unrestricted access for this site. This decommissioning plan is due to the NRC by September 5, 1997.

This letter and report are the decommissioning plan for the site. Because of the low dose resulting from this site, the decommissioning plan is simply a request for unrestricted access to the site. I believe that NRC will grant TVA unrestricted access for this site. The exact meaning on "unrestricted access" is not clear, however. The site still contains small amounts of radioactive materials and also plastic warning labels on the bags and containers that were buried. These plastic signs will probably be readable for many years. Very adverse publicity would result if someone was to dig into this site and come up with such a sign. However, unrestricted access will probably allow such digging on the site.

The US Environmental Protection Agency sets environmental radioactivity standards, not the NRC. The EPA has not agreed to the NRC's standards for this decommissioning process and a noisy dispute is currently being conducted between these two agencies on this subject.. Thus, there a remote possibility that EPA may require that some sort of analysis be conducted on this site in the future.

Also, the role of the State of Alabama concerning this site may not be clear. The State may eventually want to be satisfied that the site represents a sufficiently low hazard to the public.

The current physical status of the burial site is excellent. The site has been recently covered with a few inches of gravel to prevent erosion. I suggest that the site continue to be sprayed with herbicide to suppress vegetation, that it be inspected at regular intervals to make sure that the signs indicating pit numbers remain in place and that unplanned intrusion is avoided and that the chain link fence be maintained until its ultimate fate is decided.

The hydrological and geological information supplied by Mark Boggs and Hank Julian of TVA's Engineering Lab in Norris has been an invaluable input for the RESRAD runs. I have also directly copied portions of previous reports on the Muscle Shoals garage concerning the geology and hydrology of the nearby burial site.

I appreciate the opportunity to have worked on this project. Please excuse the submission of this report with such short time for review. If I may be of further assistance, please let me know. I may be reached at 381-4059.

Jesse H. Coleman

Jesse H. Coleman, Health Physicist

UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION II
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April 30, 1999

Tennessee Valley Authority
ATTN: David Sorrelle
Environmental Compliance
Officer at ERC
P. O. Box 1010
TVA Reservation Road
Muscle Shoals, AL 35662

SUBJECT: RELEASE OF FORMER BURIAL SITE FOR UNRESTRICTED USE

Dear Mr. Sorrelle:

This refers to the dose assessment dated September 4, 1997, submitted by the Tennessee Valley Authority (TVA) requesting unrestricted release of the inactive low-level radioactive material burial site located at the TVA-Muscle Shoals, Alabama, reservation. NRC has completed its review of the dose assessment and other supporting documents. Based on this review, the NRC considers that no further remediation is required and that the site may be released for unrestricted use.

If you have any questions concerning this letter, please contact Bryan Parker of my staff by telephone at (404) 562-4728 or by e-mail at bap@nrc.gov.

Sincerely,

Jay L. Henson
for

Thomas R. Decker, Chief
Materials/Licensing Inspection Branch 1
Division of Nuclear Materials Safety

License No. 01-06113-03 (retired)
Docket No. 030-03571 (retired)

cc: Bobby Gray, TVA
Tim Harris, NMSS

5/5/99
pc: Chuck Gilbert, CEB 4C-M
Mark Hastings, ET 11A-K
Randy Weatherington, CTR 2Q-M
Ron Williams, CTR 2C-M
Bill Raines, WAR 1A-M
Wilson McArthur, LP 2R-C
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MAY 0 5 1999
D.W. SORRELLE

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