Appendix B

Results from ANL-E Destructive Examinations

FOREWORD

Destructive examination data contained in this appendix were transmitted to G. L. Olson (INEEL) from Donald Graczyk (Analytical Chemistry, Chemistry Technology Division, Argonne National Laboratory-East) in a letter dated June 8, 1998 (no letter number). The attachment to this letter is a copy of "Information Package, ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample" transmitted to Bettis Atomic Power Laboratory on July 31, 1980. This information is available in the INEEL Electronic Records Vault, record number LWBR-0129. Chemist Steve McKinney (INEEL) reviewed the analytical methods used to obtain the data, then entered the data into an electronic format (spreadsheets), which is published here. Steve McKinney prepared the following writeup.

Extensive chemical and physical measurements were performed on 17 LWBR rods. These measurements were subject to the following predefined error requirements and specifications.

Analysis	Percent Relative Bias	Percent Relative Standard Deviation
U-isotopic (U-233 + U-235) (percent abundance)	0.05 (or 0.01 g/U-total per segment)[a]	0.08 (or 0.01 g/U-total per segment)[a]
U-total (g/segment)	0.15	0.15
Cs-137 (atoms/segment)	0.5	1.25
Ce-144 (atoms/segment)	2.0	2.0
Zr-95 (atoms/segment)	2.5[b]	4.0[b]
Rod Weight (g)[c]	0.1	0.10
Rod length (in.)	0.001	0.010
Segment weight (g)[c]	0.001 if wt <286 g, otherwise 0.01 g	0.005
Cladding segment length (in.)	0.001	0.005
Fuel segment length (in.)	0.005	0.015
Cladding segment boundary location (in.)	0.010 total	
Fuel segment boundary location (in.)	0.005	0.015

a. The larger of the two shall apply.

b. Waived after 2 years out of the reactor (10/84), for low burnup, or low concentration segments.

c. Weights are given as mass in air relative to 8.0 g/cm^3 density standard weights.

d. Not including the average fuel shear-plane displacement, which will be corrected.

Dissolution, Sample Preparation and Sampling

The physical measurements performed on the fuel rods were weight, length, and temperature of the rod surface. The rods were then sheared into predefined lengths (segments) and collected in aluminum buckets. The shearing also served to pulverize the ceramic fuel material, aiding sample dissolution. The segments (and bucket) were then dissolved in one of two high pressure, high temperature dissolver systems. The dissolution was carried out using a 4-hour dissolution in Thorex (13.6 M HNO_3, 0.06 M HF) followed by a dilute nitric acid rinse, then a 3-hour secondary dissolution in a Thorex-0.06 M Al^{+3} solution, followed by a reflux rinse (hot rinse) and cold rinse with dilute nitric acid. Operating conditions for both dissolutions were 195°C and 120 psig. A sample of the second dissolution was obtained to measure the completeness of the dissolution scheme. Both dissolutions and all rinses were then combined in a blend tank and mixed prior to further sampling. Gases emitted during dissolution were collected and analyzed for krypton and xenon.

In all, three sets of samples were obtained from each segment. The first set (two samples) was taken from the secondary dissolution prior to blending to assess the completeness of the dissolution scheme. The second set (four samples) was then taken from the blended (both dissolutions and all rinses) tank contents. The third set (four samples) was taken after the addition of a known amount of U-238 spike (NBS Standard Sample 950a). Half of the samples were analyzed, and the other half was placed in archive. Batch carryover or cross contamination was controlled and monitored by analyzing a blank (a full dissolution scheme with no segment material) between each rod, and all segments were analyzed in order of increasing uranium content.

Implicit in all measurements is that dissolution is complete, and the fuel in solution is quantitatively transferred to the blend tank.

Uranium Analysis

Total uranium and uranium isotopic (U-233, U-234, U-235, U-236, U-238) analyses were performed by thermal ionization mass spectrometry. Because of the interference of Th-232, U-232 was determined by alpha spectrometry.

Rod B—2606481: The uncertainties for uranium results for segments B-03, B-04, and B-05 may be slightly more than reported due to losses in dissolution (order of 0.01%-0.02%).

Kr/Xe Analysis

Fission gases (krypton and xenon) collected from the fuel rod plenum and during dissolution were determined by gas mass spectrometry on a "best effort" basis. Gases released during shearing were estimated by using the in line radiation monitor in the cell ventilation system. The plenum (rod void volume) contained between 0.01% and 0.15%, and about 0.17% to 0.58% of the gas was released during shearing. The rest (>99%) was released during dissolution.

Rod B—2606481: The total gram weight given in column entitled "gas released in dissolution" is incorrect. The total reflects the 0.0037 contribution of the plenum gases.

Rod C—2513854: The krypton and xenon values for C-04 were estimated using fission gas data from C-03 and C-05 and an assumed correlation with Cs-137 over the three segments.

Cs-137, Ce-144, Nb-95 Analysis

The fission products Cs-137, Ce-144, and Nb-95 were determined by gamma spectrometry (high purity germanium detector with associated automated multi-channel analyzer/data management system) on weighed aliquots of the samples obtained prior to spiking the blend tank with 950a. Cs-137 and Ce-144 were determined on a sample aliquot by direct counting. Zr-95 was obtained after processing the sample aliquot through a cleanup procedure to reduce interferences. The losses of Zr-95 were accounted for by using before and after values of the Ce-144. Error requirements for Zr-95 measurements made after October 1984 were waived because of the short half-life (64.02 days).

Rod "B" 2605481 (PFB III-6 E31)

	B-00	B-01	B-02	B-03	B-04	B-05	B-06	B-07	B-08
seg length (in)[a]	10.993	10.992	18.091	17.5	17.5	17.497	14.562	9.433	1.625
total length (in)									1.1819E+02
U-232 wt%[b]	0	0.0113	0.0283	0.1091	0.1468	0.1152	0.035	0.0184	
+/-[b]	0	0.0004	0.0009	0.0034	0.0046	0.0036	0.0011	0.0006	
U-232 g[i]	0.0000E+00	3.2265E-05	3.5353E-03	1.2495E-02	1.6474E-02	1.2847E-02	3.3564E-03	9.3788E-05	
+/-[j]	NA	1.1422E-06	1.1243E-04	3.8941E-04	5.1622E-04	4.0147E-04	1.0549E-04	3.0584E-06	
Segment Total									4.8833E-02
+/-[n]									7.7658E-04
U-233 wt%[b]	100	99.2297	93.6514	87.8209	85.6132	87.066	92.157	98.6371	
+/-[b]	0	0.021	0.0048	0.0055	0.0061	0.0056	0.005	0.0159	
U-233 g[i]	4.0000E-05	2.8333E-01	1.1699E+01	1.0058E+01	9.6073E+00	9.7092E+00	8.8375E+00	5.0277E-01	
+/-[j]	1.0000E-05	1.3332E-04	3.2861E-03	2.8971E-03	2.7077E-03	2.7619E-03	2.4345E-03	1.6870E-04	
Segment Total									5.0697E+01
+/-[n]									6.3344E-03
U-234 wt%[b]	0	0.7163	5.3256	9.9797	11.6472	10.5888	6.601	1.293	
+/-[b]	0	0.0006	0.0007	0.0009	0.0011	0.001	0.0007	0.0006	
U-234 g[i]	0.0000E+00	2.0453E-03	6.6528E-01	1.1429E+00	1.3070E+00	1.1808E+00	6.3301E-01	6.5907E-03	
+/-[j]	NA	1.9167E-06	2.0348E-04	3.3747E-04	3.7718E-04	3.4568E-04	1.8367E-04	3.6215E-06	
Segment Total									4.9377E+00
+/-[n]									6.7141E-04
U-235 wt%[b]	0	0.0125	0.6384	1.6482	2.0943	1.7634	0.8212	0.0368	
+/-[b]	0	0.0149	0.0035	0.0036	0.0037	0.0036	0.0037	0.0113	
U-235 g[i]	0.0000E+00	3.5691E-05	7.9750E-02	1.8876E-01	2.3502E-01	1.9665E-01	7.8750E-02	1.8758E-04	
+/-[j]	NA	4.2544E-05	4.3778E-04	4.1570E-04	4.2012E-04	4.0514E-04	3.5545E-04	5.7598E-05	
Segment Total									7.7915E-01
+/-[n]									9.1464E-04
U-236 wt%[b]	0	0.0004	0.081	0.1725	0.2315	0.1902	0.0981	0.0006	
+/-[b]	0	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	
U-236 g[i]	0.0000E+00	1.1421E-06	1.0119E-02	1.9756E-02	2.5978E-02	2.1210E-02	9.4074E-03	3.0583E-06	
+/-[j]	NA	5.7106E-07	1.2801E-05	1.2729E-05	1.3271E-05	1.2605E-05	9.9205E-06	1.0194E-06	
Segment Total									8.6475E-02
+/-[n]									2.7580E-05

Rod "B" 2606481 (PFB III-6 E31)

	B-00	B-01	B-02	B-03	B-04	B-05	B-06	B-07	B-08
seg length (in)[a]	10.993	10.992	18.091	17.5	17.5	17.497	14.562	9.433	1.625
total length (in)									1.1819E+02
U-238 wt%[b]	0	0.0298	0.2752	0.2696	0.2669	0.2764	0.2877	0.0146	
+/-[b]	0	0.015	0.0035	0.0036	0.0038	0.0037	0.0037	0.0114	
U-238 g[j]	0.0000E+00	8.5088E-05	3.4378E-02	3.0876E-02	2.9951E-02	3.0823E-02	2.7589E-02	7.4419E-05	
+/-[j]	NA	4.2830E-05	4.3733E-04	4.1239E-04	4.2651E-04	4.1269E-04	3.5489E-04	5.8108E-05	
Segment Total									1.5378E-01
+/-[n]									9.1908E-04
tot U[c]	0.00004	0.28553	12.49217	11.45266	11.22176	11.15151	9.5896	0.50972	
+/-[c]	0.00001	0.00012	0.00345	0.00322	0.00306	0.00309	0.00259	0.00015	
Kr-82 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-82 (g)[k]	1.1468E-06	0.0000E+00	1.8464E-04	3.2681E-04	4.1340E-04	3.3844E-04	1.6291E-04	8.7963E-06	
+/-[j]	1.1468E-06	NA	1.8510E-04	3.2834E-04	4.1461E-04	3.3898E-04	1.6382E-04	1.0777E-05	
Segment Total									1.4361E-03
+/-[n]									6.7515E-04
Kr-83 (mol%)[d]	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-83 (g)[k]	8.9381E-05	0.0000E+00	1.4391E-02	2.5472E-02	3.2221E-02	2.6378E-02	1.2697E-02	6.8559E-04	
+/-[j]	5.8040E-07	NA	1.0258E-03	2.4700E-03	2.4733E-03	1.5038E-03	1.3433E-03	4.8530E-04	
Segment Total									1.1193E-01
+/-[n]									4.1919E-03
Kr-84 (mol%)[d]	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	
+/-[d]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Kr-84 (g)[k]	1.7680E-04	0.0000E+00	2.8465E-02	5.0385E-02	6.3734E-02	5.2178E-02	2.5116E-02	1.3561E-03	
+/-[j]	1.7621E-06	NA	2.0404E-03	4.9005E-03	4.9160E-03	3.0007E-03	2.6639E-03	9.6001E-04	
Segment Total									2.2141E-01
+/-[n]									8.3288E-03

Rod "B" 2606481 (PFB III-6 E31)

	B-00	B-01	B-02	B-03	B-04	B-05	B-06	B-07	B-08
seg length (in)[a]	10.993	10.992	18.091	17.5	17.5	17.497	14.562	9.433	1.625
total length (in)									1.1819E+02
Kr-85 (mol%)[d]	6.2	6.2	6.2	6.2	6.2	6.2	6.2	6.2	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	3.6852E-05	0.0000E+00	5.9333E-03	1.0502E-02	1.3285E-02	1.0876E-02	5.2352E-03	2.8267E-04	
+/-[j]	5.9439E-07	NA	4.3191E-04	1.0301E-03	1.0384E-03	6.4048E-04	5.5921E-04	2.0013E-04	
Segment Total									4.6150E-02
+/-[n]									1.7576E-03
Kr-86 (mol%)[d]	48.2	48.2	48.2	48.2	48.2	48.2	48.2	48.2	
+/-[d]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Kr-86 (g)[k]	2.8986E-04	0.0000E+00	4.6669E-02	8.2605E-02	1.0449E-01	8.5545E-02	4.1178E-02	2.2234E-03	
+/-[j]	1.8041E-06	NA	3.3255E-03	8.0086E-03	8.0186E-03	4.8743E-03	4.3556E-03	1.5738E-03	
Segment Total									3.6300E-01
+/-[n]									1.3590E-02
Rod Total									7.4393E-01
+/-[n]									1.6589E-02
shear gas (g)[e]	0	0	0.0012	0.003	0.0039	0.0037	0.002	0.0002	
+/-[e]	NA	NA	0.0002	0.0006	0.0008	0.0008	0.0004	0	
moles Kr (diss+pl)[d]	0.000007	0	0.001125	0.00199	0.002517	0.00206	0.000991	0.000053	
+/-[d]	0	NA	0.00008	0.000193	0.000193	0.000117	0.000105	0.000038	
Kr+Xe diss+pl (g)[d]	[illegible]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
+/-[d]	0.0002	NA	0.0408	0.0544	0.0547	0.0564	0.0168	0.0086	
moles kr (tot)[o]	7.0000E-06	0	1.1270E-03	1.9949E-03	2.5234E-03	2.0658E-03	9.9441E-04	5.3693E-05	
+/-[p]	0	NA	8.0001E-05	1.9300E-04	1.9301E-04	1.1701E-04	1.0500E-04	3.8005E-05	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	0	
Xe-128 (g)[k]	2.9418E-06	0.0000E+00	5.4777E-04	1.0134E-03	1.2628E-03	1.0782E-03	4.7487E-04	1.0366E-05	
+/-[j]	1.2790E-07	NA	3.8244E-05	4.9246E-05	4.9503E-05	5.2701E-05	1.3434E-05	1.0233E-05	
SegmentTotal									4.3904E-03
+/-[n]									9.6958E-05

Rod "B" 2606481 (PFB III-6 E31)

	B-00	B-01	B-02	B-03	B-04	B-05	B-06	B-07	B-08
seg length (in)[a]	10.993	10.992	18.091	17.5	17.5	17.497	14.562	9.433	1.625
total length (in)									1.1819E+02
Xe-130 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	0	
Xe-130 (g)[k]	2.9878E-06	0.0000E+00	5.5633E-04	1.0293E-03	1.2825E-03	1.0951E-03	4.8230E-04	1.0528E-05	
+/-[j]	1.2990E-07	NA	3.8842E-05	5.0016E-05	5.0277E-05	5.3525E-05	1.3644E-05	1.0393E-05	
SegmentTotal									4.4590E-03
+/-[n]									9.8474E-05
Xe-131 (mol%)[d]	11.9	11.9	11.9	11.9	11.9	11.9	11.9	11.9	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	3.5829E-04	0.0000E+00	6.6714E-02	1.2343E-01	1.5380E-01	1.3132E-01	5.7836E-02	1.2625E-03	
+/-[j]	1.5866E-05	NA	4.6914E-03	6.0868E-03	6.1661E-03	6.5127E-03	1.7068E-03	1.2464E-03	
SegmentTotal									5.3471E-01
+/-[n]									1.1998E-02
Xe-132 (mol%)[d]	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-132 (g)[k]	6.7654E-04	0.0000E+00	1.2597E-01	2.3306E-01	2.9041E-01	2.4796E-01	1.0921E-01	2.3839E-03	
+/-[j]	3.0034E-05	NA	8.8673E-03	1.1517E-02	1.1679E-02	1.2322E-02	3.2410E-03	2.3535E-03	
SegmentTotal									1.0097E+00
+/-[n]									2.2705E-02
Xe-134 (mol%)[d]	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	
+/-[d]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Xe-134 (g)[k]	7.8228E-04	0.0000E+00	1.4566E-01	2.6949E-01	3.3580E-01	2.8672E-01	1.2628E-01	2.7565E-03	
+/-[j]	3.5245E-05	NA	1.0314E-02	1.3477E-02	1.3748E-02	1.4417E-02	3.8712E-03	2.7215E-03	
SegmentTotal									1.1675E+00
+/-[n]									2.6595E-02

Rod "B" 2606481 (PFB III-6 E31)

	B-00	B-01	B-02	B-03	B-04	B-05	B-06	B-07	B-08
seg length (in)[a]	10.993	10.992	18.091	17.5	17.5	17.497	14.562	9.433	1.625
total length (in)									1.1819E+02
Xe-136 (mol%)[d]	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-136 (g)[k]	1.2535E-03	0.0000E+00	2.3340E-01	4.3181E-01	5.3807E-01	4.5942E-01	2.0234E-01	4.4169E-03	
+/-[j]	5.4856E-05	NA	1.6337E-02	2.1093E-02	2.1263E-02	2.2572E-02	5.8124E-03	4.3604E-03	
SegmentTotal									1.8707E+00
+/-[n]									4.1548E-02
Rod total									4.5914E+00
+/-[n]									5.5615E-02
shear gas (g)[e]	0	0	0.0012	0.003	0.0039	0.0037	0.002	0.0002	
+/-[e]	0	0	0.0002	0.0006	0.0008	0.0008	0.0004	0	
moles Xe (diss+pl)[d]	0.000023	0	0.004275	0.007904	0.009848	0.008406	0.0037	0.00008	
+/-[d]	0.000001	0	0.000299	0.000385	0.000387	0.000412	0.000105	0.00008	
Kr+Xe diss&pl (g)[d]	0.0037	0	0.6693	1.2299	1.5355	1.3033	0.5808	0.0153	
+/-[d]	0.0002	0	0.0408	0.0544	0.0547	0.0564	0.0168	0.0086	
moles Xe (tot)[o]	2.3000E-05	0	4.2827E-03	7.9233E-03	9.8730E-03	8.4299E-03	3.7127E-03	8.1046E-05	
+/-[p]	1.0000E-06	0	2.9900E-04	3.8502E-04	3.8704E-04	4.1204E-04	1.0503E-04	8.0009E-05	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project									
Cs-137 (atoms)[l]	NA	2.7440E+18	6.6220E+20	1.3800E+21	1.6610E+21	1.4600E+21	6.8260E+20	8.3960E+18	
+/-[l]	NA	1.1800E+16	2.7500E+18	5.9300E+18	7.1300E+18	6.2700E+18	2.9300E+18	3.6100E+16	
Cs-137 (g)[m]	NA	6.2375E-04	1.5053E-01	3.1369E-01	3.7757E-01	3.3188E-01	1.5516E-01	1.9085E-03	
+/-[m]	NA	2.6823E-06	6.2511E-04	1.3480E-03	1.6208E-03	1.4253E-03	6.6603E-04	8.2060E-06	
Total									1.3314E+00
+/-[n]									2.7036E-03
Ce-144 (atoms)[g]	NA	3.4950E+17	4.2590E+19	7.0130E+19	8.0720E+19	6.6070E+19	2.5620E+19	4.0400E+17	
+/-[g]	NA	2.5600E+15	3.1700E+17	5.5500E+17	6.5300E+17	5.3600E+17	2.2900E+17	3.2000E+15	
Ce-144 (g)[m]	NA	8.3512E-05	1.0177E-02	1.6757E-02	1.9288E-02	1.5787E-02	6.1218E-03	9.6535E-05	
+/-[m]	NA	6.1171E-07	7.5746E-05	1.3262E-04	1.5603E-04	1.2808E-04	5.4719E-05	7.6463E-07	
Total									6.8311E-02
+/-[n]									2.5898E-04

Rod "B" 2606481 (PFB III-6 E31)

	B-00	B-01	B-02	B-03	B-04	B-05	B-06	B-07	B-08
seg length (in)[a]	10.993	10.992	18.091	17.5	17.5	17.497	14.562	9.433	1.625
total length (in)									1.1819E+02
Zr-95 (atoms)[h]	NA	3.8830E+15	3.5110E+17	5.3390E+17	5.8830E+17	3.4900E+17	6.3080E+16	7.1590E+14	
+/-[h]	NA	7.9700E+13	4.2500E+15	1.1000E+16	9.7100E+15	7.6500E+15	2.3700E+15	2.5400E+13	
Zr-95 (g)[m]	NA	6.1189E-07	5.5327E-05	8.4133E-05	9.2705E-05	5.4996E-05	9.9402E-06	1.1281E-07	
+/-[m]	NA	1.2559E-08	6.6972E-07	1.7334E-06	1.5301E-06	1.2055E-06	3.7347E-07	4.0026E-09	
Total									2.9782E-04
+/-[n]									2.7180E-06

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod B, 2606481, page 4
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod B, 2606481, page 7
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod B, 2606481, page 8
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod B, 2606481, page 10
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod B, 2606481, page 11
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod B, 2606481, page 12
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod B, 2606481, page 13
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod B, 2606481, page 14
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "C" 2513854 (PFB III-6 F73)

	C-00	C-01	C-02	C-03	C-04	C-05	C-06	C-07	C-08
seg length (in)[a]	11.146	7.991	17.955	17.498	17.502	17.498	14.527	11.405	2.649
total length (in)									1.1817E+02
U-232 wt%[b]	0	0.0101	0.0208	0.0841	0.114	0.0869	0.0249	0.0142	
+/-[b]	0	0.0003	0.0006	0.0026	0.0035	0.0027	0.0008	0.0004	
U-232 g[i]	0.0000E+00	2.1858E-05	2.6513E-03	9.8567E-03	1.3131E-02	1.0056E-02	2.4883E-03	6.4046E-05	
+/-[j]	NA	6.5052E-07	7.6484E-05	3.0474E-04	4.0315E-04	3.1247E-04	7.9947E-05	1.8042E-06	
Segment Total									3.8269E-02
+/-[n]									6.0438E-04
U-233 wt%[b]	100	99.2944	94.5303	89.6714	87.918	89.3639	93.8351	98.9518	
+/-[b]	0	0.0345	0.0047	0.0052	0.0059	0.0055	0.0064	0.0188	
U-233 g[i]	1.6000E-04	2.1489E-01	1.2050E+01	1.0510E+01	1.0126E+01	1.0342E+01	9.3769E+00	4.4630E-01	
+/-[j]	2.0000E-05	4.0413E-04	3.1951E-03	3.1795E-03	2.8772E-03	2.8686E-03	2.6768E-03	1.5407E-04	
Segment Total									5.3065E+01
+/-[n]									6.6466E-03
U-234 wt%[b]	0	0.6313	4.585	8.5514	9.9101	8.8104	5.1949	0.99	
+/-[b]	0	0.0011	0.001	0.0011	0.0012	0.0012	0.0011	0.0011	
U-234 g[i]	0.0000E+00	1.3663E-03	5.8444E-01	1.0022E+00	1.1414E+00	1.0196E+00	5.1913E-01	4.4652E-03	
+/-[j]	NA	3.4704E-06	1.9854E-04	3.2431E-04	3.4412E-04	3.0876E-04	1.8108E-04	5.1255E-06	
Segment Total									4.2727E+00
+/-[n]									6.2544E-04
U-235 wt%[b]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
+/-[b]	0	0.0249	0.0034	0.0036	0.004	0.0038	0.0048	0.0136	
U-235 g[i]	0.0000E+00	7.0337E-05	6.6398E-02	1.5160E-01	1.8708E-01	1.5396E-01	5.9059E-02	1.0419E-04	
+/-[j]	NA	5.3889E-05	4.3374E-04	4.2432E-04	4.6361E-04	4.4172E-04	4.7994E-04	6.1340E-05	
Segment Total									6.1827E-01
+/-[n]									1.0076E-03
U-236 wt%[b]	0	0.0002	0.0744	0.1342	0.17	0.1398	0.0804	0.0005	
+/-[b]	0	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	
U-236 g[i]	0.0000E+00	4.3284E-07	9.4836E-03	1.5729E-02	1.9581E-02	1.6178E-02	8.0344E-03	2.2552E-06	
+/-[j]	NA	4.3284E-07	2.5613E-05	2.3901E-05	2.3662E-05	2.3555E-05	2.0110E-05	9.0206E-07	
Segment Total									6.9008E-02
+/-[n]									5.2416E-05

Rod "C" 2513854 (PFB III-6 F73)

	C-00	C-01	C-02	C-03	C-04	C-05	C-06	C-07	C-08
seg length (in)[a]	11.146	7.991	17.955	17.498	17.502	17.498	14.527	11.405	2.649
total length (in)									1.1817E+02
U-238 wt%[b]	0	0.0314	0.2685	0.2655	0.2636	0.2687	0.2738	0.0204	
+/-[b]	0	0.0242	0.0033	0.0035	0.0039	0.0037	0.0046	0.0132	
U-238 g[i]	0.0000E+00	6.7956E-05	3.4225E-02	3.1117E-02	3.0361E-02	3.1095E-02	2.7361E-02	9.2010E-05	
+/-[j]	NA	5.2374E-05	4.2074E-04	4.1031E-04	4.4928E-04	4.2826E-04	4.5974E-04	5.9536E-05	
Segment Total									1.5432E-01
+/-[n]									9.7380E-04
tot U[c]	0.00016	0.21642	12.74682	11.72025	11.51799	11.57236	9.99298	0.45103	
+/-[c]	0.00002	0.0004	0.00332	0.00348	0.00318	0.00313	0.00277	0.00013	
Kr-82 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-82 (g)[k]	3.2765E-07	0.0000E+00	7.7214E-05	1.5535E-04	1.8619E-04	1.6113E-04	6.9034E-05	0.0000E+00	
+/-[j]	3.2765E-07	NA	7.7748E-05	1.5691E-04	1.8836E-04	1.6211E-04	6.9509E-05	NA	
Segment Total									6.4923E-04
+/-[n]									3.1186E-04
Kr-83 (mol%)[d]	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-83 (g)[k]	5.1738E-05	0.0000E+00	1.2193E-02	2.4530E-02	2.9400E-02	2.5443E-02	1.0901E-02	0.0000E+00	
+/-[j]	3.3166E-07	NA	1.4379E-03	3.4959E-03	4.5053E-03	2.8245E-03	1.2824E-03	NA	
Segment Total									1.0252E-01
+/-[n]									6.6490E-03
Kr-84 (mol%)[d]	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-84 (g)[k]	1.0036E-04	0.0000E+00	2.3650E-02	4.7582E-02	5.7028E-02	4.9352E-02	2.1145E-02	0.0000E+00	
+/-[j]	6.7129E-07	NA	2.7894E-03	6.7817E-03	8.7396E-03	5.4796E-03	2.4879E-03	NA	
Segment Total									1.9886E-01
+/-[n]									1.2898E-02

Rod "C" 2513854 (PFB III-6 F73)

	C-00	C-01	C-02	C-03	C-04	C-05	C-06	C-07	C-08
seg length (in)[a]	11.146	7.991	17.955	17.498	17.502	17.498	14.527	11.405	2.649
total length (in)									1.1817E+02
Kr-85 (mol%)[d]	6	6	6	6	6	6	6	6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	2.0379E-05	0.0000E+00	4.8025E-03	9.6620E-03	1.1580E-02	1.0021E-02	4.2937E-03	0.0000E+00	
+/-[j]	3.3965E-07	NA	5.7116E-04	1.3850E-03	1.7835E-03	1.1232E-03	5.0944E-04	NA	
Segment Total									4.0380E-02
+/-[n]									2.6356E-03
Kr-86 (mol%)[d]	48.5	48.5	48.5	48.5	48.5	48.5	48.5	48.5	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-86 (g)[k]	1.6667E-04	0.0000E+00	3.9276E-02	7.9019E-02	9.4707E-02	8.1959E-02	3.5116E-02	0.0000E+00	
+/-[j]	6.8728E-07	NA	4.6279E-03	1.1255E-02	1.4505E-02	9.0898E-03	4.1276E-03	NA	
Segment Total									3.3024E-01
+/-[n]									2.1405E-02
Rod Total									6.7265E-01
+/-[n]									2.5996E-02
shear gas (g)[e]	0	0	0.001	0.0034	0.0043	0.0037	0.0012	0.0002	
+/-[e]	0	0	0.0002	0.0006	0.0009	0.0008	0.0002	0	
moles kr (diss+pl)[d]	0.000004	0	0.000941	0.001891	0.002266	0.001961	0.000841	0	
+/-[d]	0	0	0.000111	0.00027	0.000348	0.000218	0.000099	0	
Kr+Xe diss&pl (g)[d]	0.0017	0	0.5773	1.1758	1.3996	1.2047	0.5694	0	
+/-[d]	0	0	0.0528	0.0761	0.107	0.0755	0.0472	0	
moles kr (tot)[o]	4.0000E-06	0	9.4263E-04	1.8965E-03	2.2730E-03	1.9670E-03	8.4277E-04	2.9540E-07	
+/-[p]	0	NA	1.1100E-04	2.7000E-04	3.4801E-04	2.1801E-04	9.9001E-05	NA	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-128 (g)[k]	1.5348E-06	0.0000E+00	4.7496E-04	9.7039E-04	1.1542E-03	9.9250E-04	4.7565E-04	0.0000E+00	
+/-[j]	1.5348E-06	NA	4.7753E-04	9.7284E-04	1.1583E-03	9.9495E-04	4.7770E-04	NA	
SegmentTotal									4.0692E-03
+/-[n]									1.9324E-03

Rod "C" 2513854 (PFB III-6 F73)

	C-00	C-01	C-02	C-03	C-04	C-05	C-06	C-07	C-08
seg length (in)[a]	11.146	7.991	17.955	17.498	17.502	17.498	14.527	11.405	2.649
total length (in)									1.1817E+02
Xe-130 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-130 (g)[k]	1.5588E-06	0.0000E+00	4.8239E-04	9.8556E-04	1.1722E-03	1.0080E-03	4.8309E-04	0.0000E+00	
+/-[j]	1.5588E-06	NA	4.8500E-04	9.8806E-04	1.1764E-03	1.0105E-03	4.8517E-04	NA	
SegmentTotal									4.1328E-03
+/-[n]									1.9626E-03
Xe-131 (mol%)[d]	12.4	12.4	12.4	12.4	12.4	12.4	12.4	12.4	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	1.9479E-04	0.0000E+00	6.0277E-02	1.2315E-01	1.4647E-01	1.2596E-01	6.0365E-02	2.1158E-05	
+/-[j]	1.5709E-06	NA	6.3007E-03	8.8218E-03	1.2490E-02	8.9052E-03	5.6375E-03	1.7063E-07	
SegmentTotal									5.1644E-01
+/-[n]									1.9612E-02
Xe-132 (mol%)[d]	22.6	22.6	22.6	22.6	22.6	22.6	22.6	22.6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	3.5772E-04	0.0000E+00	1.1070E-01	2.2617E-01	2.6900E-01	2.3132E-01	1.1086E-01	3.8857E-05	
+/-[j]	1.5828E-06	NA	1.1547E-02	1.6129E-02	2.2867E-02	1.6280E-02	1.0326E-02	1.7193E-07	
SegmentTotal									9.4844E-01
+/-[n]									3.5889E-02
Xe-134 (mol%)[d]	25.9	25.9	25.9	25.9	25.9	25.9	25.9	25.9	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-134 (g)[k]	4.1618E-04	0.0000E+00	1.2879E-01	2.6312E-01	3.1295E-01	2.6912E-01	1.2897E-01	4.5207E-05	
+/-[j]	3.2137E-06	NA	1.3459E-02	1.8839E-02	2.6677E-02	1.9016E-02	1.2041E-02	3.4909E-07	
SegmentTotal									1.1034E+00
+/-[n]									4.1884E-02

Rod "C" 2513854 (PFB III-6 F73)

	C-00	C-01	C-02	C-03	C-04	C-05	C-06	C-07	C-08
seg length (in)[a]	11.146	7.991	17.955	17.498	17.502	17.498	14.527	11.405	2.649
total length (in)									1.1817E+02
Xe-136 (mol%)[d]	39	39	39	39	39	39	39	39	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-136 (g)[k]	6.3605E-04	0.0000E+00	1.9683E-01	4.0213E-01	4.7829E-01	4.1130E-01	1.9711E-01	6.9089E-05	
+/-[j]	1.6309E-06	NA	2.0519E-02	2.8642E-02	4.0621E-02	2.8908E-02	1.8346E-02	1.7715E-07	
SegmentTotal									1.6864E+00
+/-[n]									6.3747E-02
Rod total									4.2629E+00
+/-[n]									8.6592E-02
shear gas (g)[e]	0	0	0.001	0.0034	0.0043	0.0037	0.0012	0.0002	
+/-[e]	0	0	0.0002	0.0006	0.0009	0.0008	0.0002	0	
moles Xe (diss+pl)[d]	0.000012	0	0.003707	0.007565	0.008996	0.007736	0.003711	0	
+/-[d]	0	0	0.000387	0.00054	0.000766	0.000545	0.000346	0	
Kr+Xe diss&pl (g)[d]	0.0017	0	0.5773	1.1758	1.3996	1.2047	0.5694	0	
+/-[d]	0	0	0.0528	0.0761	0.107	0.0755	0.0472	0	
moles Xe (tot)[o]	1.2000E-05	0	3.7134E-03	7.5869E-03	9.0236E-03	7.7598E-03	3.7188E-03	1.3035E-06	
+/-[p]	0.0000E+00	NA	3.8700E-04	5.4002E-04	7.6603E-04	5.4503E-04	3.4600E-04	0	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project									
Cs-137 (atoms)[f]	NA	1.8840E+18	5.3660E+20	1.1590E+21	1.3840E+21	1.1950E+21	5.0590E+20	5.8370E+18	
+/-[f]	NA	6.1200E+15	1.4900E+18	3.2200E+18	3.8000E+18	3.3200E+18	1.3900E+18	1.7000E+16	
Cs-137 (g)[m]	NA	4.2826E-04	1.2198E-01	2.6346E-01	3.1460E-01	2.7164E-01	1.1500E-01	1.3268E-03	
+/-[m]	NA	1.3912E-06	3.3870E-04	7.3195E-04	8.6379E-04	7.5468E-04	3.1597E-04	3.8643E-06	
Total									1.0884E+00
+/-[n]									1.4374E-03
Ce-144 (atoms)[g]	NA	2.3460E+17	3.4930E+19	6.0240E+19	6.9510E+19	5.5770E+19	1.9580E+19	2.9050E+17	
+/-[g]	NA	1.3700E+15	1.9700E+17	3.5700E+17	4.0400E+17	3.3100E+17	1.1600E+17	1.7200E+15	
Ce-144 (g)[m]	NA	5.6057E-05	8.3464E-03	1.4394E-02	1.6609E-02	1.3326E-02	4.6786E-03	6.9414E-05	
+/-[m]	NA	3.2736E-07	4.7073E-05	8.5304E-05	9.6535E-05	7.9092E-05	2.7718E-05	4.1099E-07	
Total									5.7480E-02
+/-[n]									1.6073E-04

Rod "C" 2513854 (PFB III-6 F73)

	C-00	C-01	C-02	C-03	C-04	C-05	C-06	C-07	C-08
seg length (in)[a]	11.146	7.991	17.955	17.498	17.502	17.498	14.527	11.405	2.649
total length (in)									1.1817E+02
Zr-95 (atoms)[h]	NA	2.6170E+15	2.8670E+17	4.6840E+17	5.0360E+17	3.0430E+17	5.3700E+16	5.8990E+14	
+/-[h]	NA	4.0400E+13	4.5500E+15	8.5600E+15	1.0200E+16	6.0600E+15	1.4800E+15	1.8100E+13	
Zr-95 (g)[m]	NA	4.1239E-07	4.5178E-05	7.3811E-05	7.9358E-05	4.7952E-05	8.4621E-06	9.2957E-08	
+/-[m]	NA	6.3663E-09	7.1699E-07	1.3489E-06	1.6073E-06	9.5494E-07	2.3322E-07	2.8522E-09	
Total									2.5527E-04
+/-[n]									2.4256E-06

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample -Rod C, 2513854, page 3
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod C, 2513854, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod C, 2513854, page 7
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod C, 2513854, page 9
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod C, 2513854, page 10
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod C, 2513854, page 11
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod C, 2513854, page 12
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod C, 2513854, page 13
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation $=((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "D" 2502102 (PFB III-6 H1)

	D-00	D-01	D-02	D-03	D-04	D-05	D-06	D-07	D-08
seg length (in)[a]	11.18	8.063	17.815	17.499	17.502	17.5	14.464	11.419	2.625
total length (in)									1.1807E+02
U-232 wt%[b]	0	0.0049	0.0058	0.0238	0.0336	0.0239	0.0065	0.0062	
+/-[b]	0	0.0002	0.0002	0.0007	0.001	0.0007	0.0002	0.0002	
U-232 g[i]	0.0000E+00	5.3557E-06	7.5157E-04	2.9247E-03	4.0642E-03	2.9273E-03	6.7653E-04	1.3072E-05	
+/-[j]	NA	2.1872E-07	2.5917E-05	8.6026E-05	1.2096E-04	8.5742E-05	2.0817E-05	4.2174E-07	
Segment Total									1.1363E-02
+/-[n]									1.7461E-04
U-233 wt%[b]	100	99.603	96.326	93.932	92.9686	93.9009	96.1444	99.4837	
+/-[b]	0	0.1209	0.0056	0.0058	0.0056	0.006	0.0062	0.04	
U-233 g[i]	4.0000E-05	1.0887E-01	1.2482E+01	1.1543E+01	1.1245E+01	1.1501E+01	1.0007E+01	2.0975E-01	
+/-[j]	1.0000E-05	1.9946E-04	3.3263E-03	3.3089E-03	3.1600E-03	3.2944E-03	2.7964E-03	1.3816E-04	
Segment Total									5.7097E+01
+/-[n]									7.1226E-03
U-234 wt%[b]	0	0.3175	2.7086	4.8011	5.6131	4.8292	2.8661	0.4669	
+/-[b]	0	0.0008	0.0006	0.0007	0.0007	0.0007	0.0007	0.0007	
U-234 g[i]	0.0000E+00	3.4703E-04	3.5098E-01	5.9000E-01	6.7895E-01	5.9149E-01	2.9831E-01	9.8441E-04	
+/-[j]	NA	9.9569E-07	1.1990E-04	1.8622E-04	2.0469E-04	1.8609E-04	1.0903E-04	1.5627E-06	
Segment Total									2.5111E+00
+/-[n]									3.7077E-04
U-235 wt%[b]	0	0.0042	0.1856	[illegible]	[illegible]	[illegible]	[illegible]	0.0061	
+/-[b]	0	0.0858	0.0048	0.005	0.0048	0.0051	0.0052	0.0285	
U-235 g[i]	0.0000E+00	4.5906E-06	2.4050E-02	5.5951E-02	7.1026E-02	5.5729E-02	2.1399E-02	1.2861E-05	
+/-[j]	NA	9.3779E-05	6.2202E-04	6.1464E-04	5.8092E-04	6.2485E-04	5.4126E-04	6.0089E-05	
Segment Total									2.2817E-01
+/-[n]									1.3409E-03
U-236 wt%[b]	0	0.0003	0.0162	0.0266	0.0336	0.0266	0.0164	0	
+/-[b]	0	0.0003	0.0002	0.0002	0.0002	0.0002	0.0002	0.0003	
U-236 g[i]	0.0000E+00	3.2790E-07	2.0992E-03	3.2688E-03	4.0642E-03	3.2580E-03	1.7069E-03	0.0000E+00	
+/-[j]	NA	3.2790E-07	2.5922E-05	2.4595E-05	2.4217E-05	2.4513E-05	2.0822E-05	NA	
Segment Total									1.4398E-02
+/-[n]									5.3832E-05

Rod "D" 2502102 (PFB III-6 H1)

	D-00	D-01	D-02	D-03	D-04	D-05	D-06	D-07	D-08
seg length (in)[a]	11.18	8.063	17.815	17.499	17.502	17.5	14.464	11.419	2.625
total length (in)									1.1807E+02
U-238 wt%[b]	0	0.0701	0.7578	0.7612	0.7639	0.7644	0.761	0.037	
+/-[b]	0	0.0858	0.0031	0.0035	0.0033	0.0037	0.0037	0.0283	
U-238 g[i]	0.0000E+00	7.6619E-05	9.8196E-02	9.3543E-02	9.2399E-02	9.3626E-02	7.9206E-02	7.8011E-05	
+/-[j]	NA	9.3779E-05	4.0251E-04	4.3091E-04	3.9996E-04	4.5394E-04	3.8570E-04	5.9668E-05	
Segment Total									4.5712E-01
+/-[n]									9.3533E-04
tot U[c]	0.00042	0.1093	12.95802	12.28886	12.09575	12.24824	10.40818	0.21084	
+/-[c]	0.00002	0.00015	0.00337	0.00344	0.00332	0.00342	0.00283	0.00011	
Kr-82 (mol%)[d]	0	0	0	0	0	0	0	0	
+/-[d]	0	0	0	0	0	0	0	0	
Kr-82 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[j]	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total									0.0000E+00
+/-[n]									NA
Kr-83 (mol%)[d]	16.4	16.4	16.4	16.4	16.4	16.4	16.4	16.4	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-83 (g)[k]	0.0000E+00	0.0000E+00	6.0609E-03	1.1997E-02	1.6864E-02	1.3516E-02	5.4763E-03	2.4723E-06	
+/-[j]	NA	NA	1.5098E-03	1.7964E-03	1.4044E-03	1.3487E-03	1.0883E-03	1.5075E-08	
Segment Total									5.3916E-02
+/-[n]									3.2377E-03
Kr-84 (mol%)[d]	29.1	29.1	29.1	29.1	29.1	29.1	29.1	29.1	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-84 (g)[k]	0.0000E+00	0.0000E+00	1.0884E-02	2.1543E-02	3.0283E-02	2.4272E-02	9.8339E-03	4.4397E-06	
+/-[j]	NA	NA	2.7115E-03	3.2266E-03	2.5238E-03	2.4232E-03	1.9546E-03	3.0513E-08	
Segment Total									9.6820E-02
+/-[n]									5.8160E-03

Rod "D" 2502102 (PFB III-6 H1)

	D-00	D-01	D-02	D-03	D-04	D-05	D-06	D-07	D-08
seg length (in)[a]	11.18	8.063	17.815	17.499	17.502	17.5	14.464	11.419	2.625
total length (in)									1.1807E+02
Kr-85 (mol%)[d]	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	0.0000E+00	0.0000E+00	2.3087E-03	4.5698E-03	6.4236E-03	5.1485E-03	2.0860E-03	9.4176E-07	
+/-[j]	NA	NA	5.7619E-04	6.8781E-04	5.4382E-04	5.1970E-04	4.1578E-04	9.6516E-07	
Segment Total									2.0538E-02
+/-[n]									1.2425E-03
Kr-86 (mol%)[d]	48.5	48.5	48.5	48.5	48.5	48.5	48.5	48.5	
+/-[d]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Kr-86 (g)[k]	0.0000E+00	0.0000E+00	1.8572E-02	3.6761E-02	5.1673E-02	4.1416E-02	1.6780E-02	7.5758E-06	
+/-[j]	NA	NA	4.6265E-03	5.5048E-03	4.3037E-03	4.1330E-03	3.3349E-03	7.7632E-06	
Segment Total									1.6521E-01
+/-[n]									9.9213E-03
Rod Total									3.3648E-01
+/-[n]									1.2012E-02
shear gas (g)[e]	0	0	0.0004	0.0015	0.0024	0.0017	0.0004	0.0001	
+/-[e]	0	0.0001	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0001	
moles Kr (diss+pl)[d]	0	0	0.000445	0.00088	0.001236	0.000991	0.000402	0	
+/-[d]	0	0	0.000111	0.000132	0.000103	0.000099	0.00008	0	
Kr+Xe diss&pl (g)[d]	0.0003	0	0.2469	0.5823	0.7126	0.5627	0.2211	0	
+/-[d]	0	0	0.0313	0.0543	0.0424	0.0408	0.0226	0	
moles kr (tot)[o]	0.0000E+00	0.0000E+00	4.4572E-04	8.8227E-04	1.2402E-03	9.9399E-04	4.0273E-04	1.8182E-07	
+/-[p]	0	NA	1.1100E-04	1.3200E-04	1.0300E-04	9.9002E-05	8.0000E-05	1.8631E-07	
Xe-128 (mol%)[d]	0	0	0	0	0	0	0	0	
+/-[d]	0	0	0	0	0	0	0	0	
Xe-128 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[j]	NA	NA	NA	NA	NA	NA	NA	NA	
SegmentTotal									0.0000E+00
+/-[n]									NA

Rod "D" 2502102 (PFB III-6 H1)

	D-00	D-01	D-02	D-03	D-04	D-05	D-06	D-07	D-08
seg length (in)[a]	11.18	8.063	17.815	17.499	17.502	17.5	14.464	11.419	2.625
total length (in)									1.1807E+02
Xe-130 (mol%)[d]	0	0	0	0	0	0	0	0	
+/-[d]	0	0	0	0	0	0	0	0	
Xe-130 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[j]	NA	NA	NA	NA	NA	NA	NA	NA	
SegmentTotal									0.0000E+00
+/-[n]									NA
Xe-131 (mol%)[d]	13.9	13.9	13.9	13.9	13.9	13.9	13.9	13.9	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	3.6392E-05	0.0000E+00	2.8413E-02	6.9030E-02	8.2723E-02	6.5119E-02	2.5411E-02	1.1472E-05	
+/-[j]	2.6181E-07	NA	4.0630E-03	7.2228E-03	5.6543E-03	5.4246E-03	2.9354E-03	8.2534E-08	
SegmentTotal									2.7074E-01
+/-[n]									1.1777E-02
Xe-132 (mol%)[d]	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	5.8829E-05	0.0000E+00	4.5932E-02	1.1159E-01	1.3373E-01	1.0527E-01	4.1078E-02	1.8545E-05	
+/-[j]	2.6381E-07	NA	6.5629E-03	1.1659E-02	9.1095E-03	8.7491E-03	4.7397E-03	8.3163E-08	
SegmentTotal									4.3767E-01
+/-[n]									1.9000E-02
Xe-134 (mol%)[d]	27.3	27.3	27.3	27.3	27.3	27.3	27.3	27.3	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-134 (g)[k]	7.3112E-05	0.0000E+00	5.7083E-02	1.3868E-01	1.6619E-01	1.3083E-01	5.1051E-02	2.3048E-05	
+/-[j]	2.6781E-07	NA	8.1550E-03	1.4485E-02	1.1313E-02	1.0868E-02	5.8889E-03	8.4425E-08	
SegmentTotal									5.4394E-01
+/-[n]									2.3603E-02

Rod "D" 2502102 (PFB III-6 H1)

	D-00	D-01	D-02	D-03	D-04	D-05	D-06	D-07	D-08
seg length (in)[a]	11.18	8.063	17.815	17.499	17.502	17.5	14.464	11.419	2.625
total length (in)									1.1807E+02
Xe-136 (mol%)[d]	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-136 (g)[k]	9.9212E-05	0.0000E+00	7.7461E-02	1.8819E-01	2.2552E-01	1.7753E-01	6.9276E-02	3.1276E-05	
+/-[j]	2.7181E-07	NA	1.1065E-02	1.9651E-02	1.5342E-02	1.4741E-02	7.9894E-03	3.3702E-05	
SegmentTotal									7.3811E-01
+/-[n]									3.2017E-02
Rod total									1.9905E+00
+/-[n]									4.5628E-02
shear gas (g)[e]	0	0	0.0004	0.0015	0.0024	0.0017	0.0004	0.0001	
+/-[e]	0	0.0001	0.0003	0.0003	0.0005	0.0003	0.0003	0.0001	
moles Xe (diss+pl)[d]	0.000002	0	0.001559	0.003784	0.004531	0.003568	0.001394	0	
+/-[d]	0	0	0.000223	0.000396	0.000309	0.000297	0.000161	0	
Kr+Xe diss&pl (g)[d]	0.0003	0	0.2469	0.5823	0.7126	0.5627	0.2211	0	
+/-[d]	0	0	0.0313	0.0543	0.0424	0.0408	0.0226	0	
moles Xe (tot)[o]	2.0000E-06	0	1.5615E-03	3.7937E-03	4.5463E-03	3.5788E-03	1.3965E-03	6.3048E-07	
+/-[p]	0.0000E+00	0	2.2301E-04	3.9601E-04	3.0902E-04	2.9701E-04	1.6101E-04	6.7939E-07	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project									
Cs-137 (atoms)[l]	NA	5.3940E+17	2.6590E+20	6.0010E+20	7.3300E+20	6.0410E+20	2.3460E+20	1.3880E+18	
+/-[l]	NA	2.1500E+15	9.1300E+17	2.0600E+18	2.5800E+18	2.0600E+18	8.0600E+17	5.0700E+15	
Cs-137 (g)[m]	NA	1.2261E-04	6.0443E-02	1.3641E-01	1.6662E-01	1.3732E-01	5.3328E-02	3.1551E-04	
+/-[m]	NA	4.8873E-07	2.0754E-04	4.6827E-04	5.8647E-04	4.6827E-04	1.8322E-04	1.1525E-06	
Total									5.5456E-01
+/-[n]									9.2690E-04
Ce-144 (atoms)[g]	NA	6.6290E+16	1.7390E+19	3.2310E+19	3.8610E+19	2.8740E+19	9.4270E+18	7.4840E+16	
+/-[g]	NA	3.9800E+14	1.0100E+17	1.9400E+17	2.3100E+17	1.7200E+17	5.6600E+16	4.7400E+14	
Ce-144 (g)[m]	NA	1.5840E-05	4.1553E-03	7.7204E-03	9.2258E-03	6.8674E-03	2.2526E-03	1.7883E-05	
+/-[m]	NA	9.5101E-08	2.4134E-05	4.6356E-05	5.5197E-05	4.1099E-05	1.3524E-05	1.1326E-07	
Total									3.0255E-02
+/-[n]									8.7465E-05

Rod "D" 2502102 (PFB III-6 H1)

	D-00	D-01	D-02	D-03	D-04	D-05	D-06	D-07	D-08
seg length (in)[a]	11.18	8.063	17.815	17.499	17.502	17.5	14.464	11.419	2.625
total length (in)									1.1807E+02
Zr-95 (atoms)[h]	NA	6.7580E+14	1.4830E+17	2.6000E+17	2.9880E+17	1.5980E+17	2.8380E+16	1.8320E+14	
+/-[h]	NA	1.0800E+13	1.8800E+15	3.4800E+15	4.6900E+15	3.1600E+15	9.5600E+14	8.8300E+12	
Zr-95 (g)[m]	NA	1.0649E-07	2.3369E-05	4.0971E-05	4.7085E-05	2.5181E-05	4.4721E-06	2.8869E-08	
+/-[m]	NA	1.7019E-09	2.9625E-07	5.4838E-07	7.3906E-07	4.9796E-07	1.5065E-07	1.3914E-09	
Total									1.4121E-04
+/-[n]									1.0979E-06

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod D, 2502102, page 3
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod D, 2502102, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod D, 2502102, page 7
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod D, 2502102, page 9
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod D, 2502102, page 10
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod D, 2502102, page 11
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod D, 2502102, page 12
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod D, 2502102, page 13
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "E" 2102187 (PFB III-6 B62)

	E-00	E-01	E-02	E-03	E-04	E-05	E-06	E-07	E-08
seg length (in)[a]	11.327	8.489	14.129	14	14.101	17.498	17.504	18.426	2.627
total length (in)									1.1810E+02
U-232 wt%[b]	0	0.0116	0.0245	0.0926	0.1448	0.2068	0.1461	0.0452	
+/-[b]	0	0.0004	0.0008	0.0029	0.0045	0.0064	0.0045	0.0014	
U-232 g[i]	0.0000E+00	2.9860E-05	1.6122E-03	6.2204E-03	9.9839E-03	1.1219E-02	6.2710E-03	6.4911E-04	
+/-[j]	NA	1.0297E-06	5.2646E-05	1.9481E-04	3.1029E-04	3.4722E-04	1.9316E-04	2.0106E-05	
Segment Total									3.5986E-02
+/-[n]									5.4339E-04
U-233 wt%[b]	100	99.2317	94.611	90.1459	87.6984	90.8655	93.1347	97.5695	
+/-[b]	0	0.0237	0.0076	0.0076	0.0082	0.0079	0.0085	0.0101	
U-233 g[i]	4.0000E-05	2.5543E-01	6.2259E+00	6.0555E+00	6.0468E+00	4.9295E+00	3.9976E+00	1.4012E+00	
+/-[j]	1.0000E-05	1.1648E-04	1.7115E-03	1.6667E-03	1.7181E-03	1.1970E-03	9.9159E-04	3.9813E-04	
Segment Total									2.8912E+01
+/-[n]									3.3537E-03
U-234 wt%[b]	0	0.7098	4.6147	8.2562	10.1189	7.7469	5.9873	2.2549	
+/-[b]	0	0.0004	0.0006	0.0009	0.0012	0.0008	0.0007	0.0004	
U-234 g[i]	0.0000E+00	1.8271E-03	3.0367E-01	5.5461E-01	6.9770E-01	4.2028E-01	2.5699E-01	3.2382E-02	
+/-[j]	NA	1.2506E-06	8.9064E-05	1.5738E-04	2.0467E-04	1.0471E-04	6.6454E-05	1.0316E-05	
Segment Total									2.2675E+00
+/-[n]									3.0013E-04
U-235 wt%[b]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
+/-[b]	0	0.0169	0.0057	0.0058	0.0057	0.0042	0.0056	0.0072	
U-235 g[i]	0.0000E+00	3.4493E-05	2.9744E-02	7.9179E-02	1.1547E-01	6.0088E-02	2.9806E-02	1.6903E-03	
+/-[j]	NA	4.3502E-05	3.7517E-04	3.9016E-04	3.9423E-04	2.2826E-04	2.4047E-04	1.0340E-04	
Segment Total									3.1601E-01
+/-[n]									7.5559E-04
U-236 wt%[b]	0	0.0003	0.0454	0.0981	0.1511	0.0697	0.0339	0.0027	
+/-[b]	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
U-236 g[i]	0.0000E+00	7.7223E-07	2.9875E-03	6.5898E-03	1.0418E-02	3.7813E-03	1.4551E-03	3.8774E-05	
+/-[j]	NA	2.5741E-07	6.6272E-06	6.9358E-06	7.4401E-06	5.4924E-06	4.3054E-06	1.4361E-06	
Segment Total									2.5272E-02
+/-[n]									1.4079E-05

Rod "E" 2102187 (PFB III-6 B62)

	E-00	E-01	E-02	E-03	E-04	E-05	E-06	E-07	E-08
seg length (in)[a]	11.327	8.489	14.129	14	14.101	17.498	17.504	18.426	2.627
total length (in)									1.1810E+02
U-238 wt%[b]	0	0.0332	0.2524	0.2284	0.2122	0.0035	0.0037	0.0099	
+/-[b]	0	0.0169	0.0056	0.0055	0.0058	0.0041	0.0055	0.0072	
U-238 g[i]	0.0000E+00	8.5460E-05	1.6609E-02	1.5343E-02	1.4631E-02	1.8988E-04	1.5881E-04	1.4217E-04	
+/-[j]	NA	4.3502E-05	3.6853E-04	3.6948E-04	3.9993E-04	2.2243E-04	2.3608E-04	1.0340E-04	
Segment Total									4.7159E-02
+/-[n]									7.4166E-04
tot U[c]	0.0008	0.25741	6.58049	6.71745	6.89499	5.42509	4.29228	1.43608	
+/-[c]	0.00002	0.0001	0.00173	0.00176	0.00185	0.00123	0.00099	0.00038	
Kr-82 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-82 (g)[k]	8.1913E-08	0.0000E+00	4.8389E-05	9.8201E-05	1.3335E-04	8.0324E-05	4.2103E-05	6.0764E-06	
+/-[j]	8.1913E-08	0.0000E+00	5.0154E-05	9.9029E-05	1.3401E-04	8.0819E-05	4.2585E-05	6.7903E-06	
Segment Total									4.0853E-04
+/-[n]									1.9665E-04
Kr-83 (mol%)[d]	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-83 (g)[k]	1.2935E-05	0.0000E+00	7.6408E-03	1.5507E-02	2.1057E-02	1.2684E-02	6.6483E-03	9.5950E-04	
+/-[j]	1.6583E-07	0.0000E+00	2.0848E-03	2.0276E-03	2.1128E-03	1.4192E-03	1.0125E-03	4.7875E-04	
Segment Total									6.4509E-02
+/-[n]									4.0236E-03
Kr-84 (mol%)[d]	29.7	29.7	29.7	29.7	29.7	29.7	29.7	29.7	
+/-[d]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Kr-84 (g)[k]	2.4922E-05	0.0000E+00	1.4722E-02	2.9877E-02	4.0572E-02	2.4438E-02	1.2810E-02	1.8487E-03	
+/-[j]	2.5173E-07	0.0000E+00	4.0152E-03	3.8995E-03	4.0581E-03	2.7277E-03	1.9482E-03	9.2231E-04	
Segment Total									1.2429E-01
+/-[n]									7.7384E-03

Rod "E" 2102187 (PFB III-6 B62)

	E-00	E-01	E-02	E-03	E-04	E-05	E-06	E-07	E-08
seg length (in)[a]	11.327	8.489	14.129	14	14.101	17.498	17.504	18.426	2.627
total length (in)									1.1810E+02
Kr-85 (mol%)[d]	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-85 (g)[k]	5.1797E-06	0.0000E+00	3.0598E-03	6.2096E-03	8.4324E-03	5.0792E-03	2.6623E-03	3.8423E-04	
+/-[j]	1.6982E-07	0.0000E+00	8.3994E-04	8.3329E-04	8.8349E-04	5.8864E-04	4.1334E-04	1.9206E-04	
Segment Total									2.5833E-02
+/-[n]									1.6537E-03
Kr-86 (mol%)[d]	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	
+/-[d]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Kr-86 (g)[k]	4.1753E-05	0.0000E+00	2.4664E-02	5.0055E-02	6.7973E-02	4.0943E-02	2.1460E-02	3.0972E-03	
+/-[j]	2.5773E-07	0.0000E+00	6.7239E-03	6.5208E-03	6.7770E-03	4.5581E-03	3.2594E-03	1.5450E-03	
Segment Total									2.0823E-01
+/-[n]									1.2940E-02
Rod Total									4.2328E-01
+/-[n]									1.5694E-02
shear gas (g)[e]	0	0	0.0004	0.0016	0.0023	0.0015	0.0006	0.0001	
+/-[e]	0	0.0001	0.0001	0.0003	0.0005	0.0003	0.0001	0.0001	
moles Kr (diss+pl)[d]	0.000001		[illegible]	[illegible]	0.001624	[illegible]	0.000513	0.000074	
+/[d]	0	0	0.000161	0.000156	0.000162	0.000109	0.000078	0.000037	
Kr+Xe diss&pl (g)[d]	0.0005	0	0.3238	0.674	0.937	0.5643	0.3104	0.041	
+/[d]	0	0	0.0319	0.0248	0.0322	0.0238	0.0289	0.0111	
moles kr (tot)[o]	1.0000E-06	0.0000E+00	5.9073E-04	1.1988E-03	1.6280E-03	9.8060E-04	5.1399E-04	7.4180E-05	
+/-[p]	0	NA	1.6100E-04	1.5600E-04	1.6200E-04	1.0900E-04	7.8000E-05	3.7001E-05	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-128 (g)[k]	3.8371E-07	0.0000E+00	2.6112E-04	5.4680E-04	7.6328E-04	4.5975E-04	2.5476E-04	3.3208E-05	
+/-[j]	3.8371E-07	NA	2.6256E-04	5.4717E-04	7.6378E-04	4.6023E-04	2.5616E-04	3.4711E-05	
SegmentTotal									2.3193E-03
+/-[n]									1.1092E-03

Rod "E" 2102187 (PFB III-6 B62)

	E-00	E-01	E-02	E-03	E-04	E-05	E-06	E-07	E-08
seg length (in)[a]	11.327	8.489	14.129	14	14.101	17.498	17.504	18.426	2.627
total length (in)									1.1810E+02
Xe-130 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-130 (g)[k]	3.8971E-07	0.0000E+00	2.6520E-04	5.5535E-04	7.7521E-04	4.6694E-04	2.5875E-04	3.3727E-05	
+/-[j]	3.8971E-07	NA	2.6667E-04	5.5572E-04	7.7573E-04	4.6742E-04	2.6017E-04	3.5254E-05	
SegmentTotal									2.3556E-03
+/-[n]									1.1265E-03
Xe-131 (mol%)[d]	12.1	12.1	12.1	12.1	12.1	12.1	12.1	12.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	4.7519E-05	0.0000E+00	3.2337E-02	6.7716E-02	9.4524E-02	5.6936E-02	3.1550E-02	4.1124E-03	
+/-[j]	3.9272E-07	NA	3.4160E-03	2.5337E-03	3.5252E-03	2.6246E-03	3.3207E-03	1.2518E-03	
SegmentTotal									2.8722E-01
+/-[n]									7.0710E-03
Xe-132 (mol%)[d]	21.9	21.9	21.9	21.9	21.9	21.9	21.9	21.9	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	8.6661E-05	0.0000E+00	5.8973E-02	1.2350E-01	1.7239E-01	1.0384E-01	5.7538E-02	7.5000E-03	
+/-[j]	3.9571E-07	NA	6.2166E-03	4.5419E-03	6.3184E-03	4.7327E-03	6.0431E-03	2.2824E-03	
SegmentTotal									5.2382E-01
+/-[n]									1.2780E-02
Xe-134 (mol%)[d]	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-134 (g)[k]	1.0204E-04	0.0000E+00	6.9436E-02	1.4541E-01	2.0297E-01	1.2226E-01	6.7746E-02	8.8306E-03	
+/-[j]	8.0343E-07	NA	7.3330E-03	5.4284E-03	7.5525E-03	5.6273E-03	7.1285E-03	2.6879E-03	
SegmentTotal									6.1675E-01
+/-[n]									1.5165E-02

Rod "E" 2102187 (PFB III-6 B62)

	E-00	E-01	E-02	E-03	E-04	E-05	E-06	E-07	E-08
seg length (in)[a]	11.327	8.489	14.129	14	14.101	17.498	17.504	18.426	2.627
total length (in)									1.1810E+02
Xe-136 (mol%)[d]	40.4	40.4	40.4	40.4	40.4	40.4	40.4	40.4	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-136 (g)[k]	1.6472E-04	0.0000E+00	1.1209E-01	2.3473E-01	3.2766E-01	1.9736E-01	1.0937E-01	1.4255E-02	
+/-[j]	8.1544E-07	NA	1.1818E-02	8.6446E-03	1.2026E-02	9.0036E-03	1.1488E-02	4.3384E-03	
SegmentTotal									9.9563E-01
+/-[n]									2.4308E-02
Rod total									2.4281E+00
+/-[n]									3.2198E-02
shear gas (g)[e]	0	0	0.0004	0.0016	0.0023	0.0015	0.0006	0.0001	
+/-[e]	0	0.0001	0.0001	0.0003	0.0005	0.0003	0.0001	0.0001	
moles Xe (diss+pl)[d]	0.000003	0	0.002039	0.004265	0.005953	0.003585	0.001988	0.000259	
+/-[d]	0	0	0.000215	0.000156	0.000217	0.000163	0.000209	0.000079	
Kr+Xe diss&pl (g)[d]	0.0005	0	0.3238	0.674	0.937	0.5643	0.3104	0.041	
+/-[d]	0	0	0.0319	0.0248	0.0322	0.0238	0.0289	0.0111	
moles Xe (tot)[o]	3.0000E-06	0	2.0415E-03	4.2751E-03	5.9676E-03	3.5945E-03	1.9918E-03	2.5963E-04	
+/-[p]	0.0000E+00	NA	2.1500E-04	1.5601E-04	2.1702E-04	1.6301E-04	2.0900E-04	7.9003E-05	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project									
Cs-137 (atoms)[l]	NA	2.4670E+18	3.0540E+20	6.7250E+20	8.8880E+20	5.2550E+20	3.1760E+20	4.0050E+19	
+/-[l]	NA	9.0570E+15	1.0580E+18	2.3980E+18	3.0740E+18	1.9270E+18	1.1640E+18	1.3830E+17	
Cs-137 (g)[m]	NA	5.6078E-04	6.9422E-02	1.5287E-01	2.0204E-01	1.1945E-01	7.2195E-02	9.1039E-03	
+/-[m]	NA	2.0588E-06	2.4050E-04	5.4510E-04	6.9876E-04	4.3803E-04	2.6459E-04	3.1438E-05	
Total									6.2564E-01
+/-[n]									1.0517E-03
Ce-144 (atoms)[g]	NA	3.1840E+17	2.1360E+19	3.7720E+19	4.6570E+19	3.8390E+19	2.0250E+19	2.1750E+18	
+/-[g]	NA	2.3330E+15	1.5470E+17	2.7950E+17	3.4510E+17	2.8450E+17	1.5000E+17	1.6110E+16	
Ce-144 (g)[m]	NA	7.6081E-05	5.1039E-03	9.0131E-03	1.1128E-02	9.1732E-03	4.8387E-03	5.1971E-04	
+/-[m]	NA	5.5747E-07	3.6965E-05	6.6786E-05	8.2461E-05	6.7981E-05	3.5842E-05	3.8494E-06	
Total									3.9853E-02
+/-[n]									1.3619E-04

Rod "E" 2102187 (PFB III-6 B62)

	E-00	E-01	E-02	E-03	E-04	E-05	E-06	E-07	E-08
seg length (in)[a]	11.327	8.489	14.129	14	14.101	17.498	17.504	18.426	2.627
total length (in)									1.1810E+02
Zr-95 (atoms)[h,r]	NA	3.4020E+15	1.8000E+17	2.9640E+17	3.5200E+17	2.7990E+17	9.4330E+16	5.1690E+15	
+/-[h,r]	NA	4.4230E+13	2.4600E+15	5.8530E+15	9.7460E+15	6.8750E+15	2.6110E+15	1.4550E+14	
Zr-95 (g)[m]	NA	5.3609E-07	2.8365E-05	4.6707E-05	5.5469E-05	4.4107E-05	1.4865E-05	8.1454E-07	
+/-[m]	NA	6.9698E-09	3.8765E-07	9.2232E-07	1.5358E-06	1.0834E-06	4.1144E-07	2.2928E-08	
Total									1.9086E-04
+/-[n]									2.1687E-06

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod E, 2102187, page 3
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod E, 2102187, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod E, 2102187, page 7
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod E, 2102187, page 10
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod E, 2102187, page 11
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod E, 2102187, page 12
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod E, 2102187, page 13
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod E, 2102187, page 14
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table
r. Zr-95 values for segments 5 and 6 corrected per LWBR EOL Sample - Rod E, 2102187, page 14, February 1985

Rod "F" 2400408 (PFB III-6 C13)

	F-00	F-01	F-02	F-03	F-04	F-05	F-06	F-07	F-08	F-09
seg length (in)[a]	11.283	11.575	14.019	14	14	14.198	14.003	10.499	12.917	1.642
total length (in)										1.1814E+02
U-232 wt%[b]	0	0.0092	0.0134	0.0528	0.0858	0.0907	0.1463	0.0766	0.0231	
+/-[b]	0	0.0003	0.0004	0.0016	0.0027	0.0028	0.0045	0.0024	0.0007	
U-232 g[i]	0.0000E+00	1.9378E-05	1.0351E-03	4.0766E-03	6.6307E-03	6.9198E-03	4.4870E-03	1.1671E-03	1.4448E-04	
+/-[j]	NA	6.3197E-07	3.0901E-05	1.2354E-04	2.0867E-04	2.1363E-04	1.3802E-04	3.6568E-05	4.3783E-06	
Segment Total										2.4480E-02
+/-[n]										3.5469E-04
U-233 wt%[b]	100	99.4304	95.7489	92.572	90.6675	89.9319	94.6369	96.5093	98.7043	
+/-[b]	0	0.0369	0.0055	0.0067	0.0073	0.0068	0.0083	0.0105	0.0119	
U-233 g[i]	4.0000E-05	2.0943E-01	7.3964E+00	7.1474E+00	7.0069E+00	6.8612E+00	2.9025E+00	1.4704E+00	6.1735E-01	
+/-[j]	1.0000E-05	1.3418E-04	2.1583E-03	2.1911E-03	2.2567E-03	2.1412E-03	8.1671E-04	4.7189E-04	1.9263E-04	
Segment Total										3.3612E+01
+/-[n]										4.4813E-03
U-234 wt%[b]	0	0.4954	3.6109	6.2902	7.8107	8.4044	4.7359	3.1883	1.22	
+/-[b]	0	0.0004	0.0004	0.0007	0.0009	0.0009	0.0006	0.0005	0.0004	
U-234 g[i]	0.0000E+00	1.0435E-03	2.7894E-01	4.8566E-01	6.0362E-01	6.4120E-01	1.4525E-01	4.8577E-02	7.6305E-03	
+/-[j]	NA	1.0034E-06	8.5574E-05	1.5444E-04	2.0068E-04	2.0593E-04	4.2974E-05	1.6527E-05	3.3289E-06	
Segment Total										2.2119E+00
+/-[n]										3.4056E-04
U-235 wt%[b]	0	0.0153	0.3238	0.7696	1.1037	1.2264	0.4598	0.2133	0.0345	
+/-[b]	0	0.0267	0.0042	0.005	0.0054	0.005	0.0054	0.0076	0.0087	
U-235 g[i]	0.0000E+00	3.2226E-05	2.5013E-02	5.9420E-02	8.5295E-02	9.3567E-02	1.4102E-02	3.2498E-03	2.1578E-04	
+/-[j]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Segment Total										2.8089E-01
+/-[n]										7.8919E-04
U-236 wt%[b]	0	0.0002	0.0391	0.063	0.0882	0.1001	0.0167	0.0054	0.0005	
+/-[b]	0	0.0001	0	0	0	0	0	0	0.0001	
U-236 g[i]	0.0000E+00	4.2126E-07	3.0204E-03	4.8641E-03	6.8162E-03	7.6370E-03	5.1219E-04	8.2274E-05	3.1273E-06	
+/-[j]	NA	2.1063E-07	8.6411E-07	1.4490E-06	2.1256E-06	2.3123E-06	1.3694E-07	2.4840E-08	6.2545E-07	
Segment Total										2.2936E-02
+/-[n]										3.6285E-06

Rod "F" 2400408 (PFB III-6 C13)

	F-00	F-01	F-02	F-03	F-04	F-05	F-06	F-07	F-08	F-09
seg length (in)[a]	11.283	11.575	14.019	14	14	14.198	14.003	10.499	12.917	1.642
total length (in)										1.1814E+02
U-238 wt%[b]	0	0.0495	0.2638	0.2523	0.2441	0.2466	0.0044	0.0071	0.0177	
+/-[b]	0	0.0258	0.0039	0.0048	0.0052	0.0048	0.0052	0.0073	0.0083	
U-238 g[j]	0.0000E+00	1.0426E-04	2.0378E-02	1.9480E-02	1.8864E-02	1.8814E-02	1.3495E-04	1.0817E-04	1.1070E-04	
+/-[j]	NA	5.4343E-05	3.0133E-04	3.7065E-04	4.0191E-04	3.6625E-04	1.5948E-04	1.1122E-04	5.1912E-05	
Segment Total										7.7994E-02
+/-[n]										7.5319E-04
tot U[c]	0.00006	0.21063	7.72484	7.72086	7.72813	7.62938	3.06699	1.52359	0.62545	
+/-[c]	0.00001	0.00011	0.00221	0.0023	0.00241	0.00231	0.00082	0.00046	0.00018	
Kr-82 (mol%)[d]	0	0	0	0	0	0	0	0	0	
+/-[d]	0	0	0	0	0	0	0	0	0	
Kr-82 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[j]	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total										0.0000E+00
+/-[n]										NA
Kr-83 (mol%)[d]	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-83 (g)[k]	1.3183E-05	0.0000E+00	5.6471E-03	1.0908E-02	1.4307E-02	1.7861E-02	3.7483E-03	1.3579E-03	6.4598E-04	
+/-[j]	1.6583E-07	NA	6.4988E-04	1.1028E-03	1.4351E-03	1.4414E-03	3.4599E-04	3.9587E-04	6.4604E-04	
Segment Total										5.4489E-02
+/-[n]										2.5436E-03
Kr-84 (mol%)[d]	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-84 (g)[k]	2.4586E-05	0.0000E+00	1.0532E-02	2.0343E-02	2.6682E-02	3.3309E-02	6.9904E-03	2.5324E-03	1.2047E-03	
+/-[j]	1.6782E-07	NA	1.2069E-03	2.0454E-03	2.6616E-03	2.6650E-03	6.4102E-04	7.3778E-04	1.2047E-03	
Segment Total										1.0162E-01
+/-[n]										4.7152E-03

Rod "F" 2400408 (PFB III-6 C13)

	F-00	F-01	F-02	F-03	F-04	F-05	F-06	F-07	F-08	F-09
seg length (in)[a]	11.283	11.575	14.019	14	14	14.198	14.003	10.499	12.917	1.642
total length (in)										1.1814E+02
Kr-85 (mol%)[d]	6	6	6	6	6	6	6	6	6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	5.0947E-06	0.0000E+00	2.1823E-03	4.2155E-03	5.5291E-03	6.9024E-03	1.4486E-03	5.2476E-04	2.4964E-04	
+/-[j]	8.4912E-08	NA	2.5228E-04	4.2866E-04	5.5790E-04	5.6214E-04	1.3465E-04	1.5309E-04	2.4968E-04	
Segment Total										2.1057E-02
+/-[n]										9.8922E-04
Kr-86 (mol%)[d]	48.8	48.8	48.8	48.8	48.8	48.8	48.8	48.8	48.8	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-86 (g)[k]	4.1924E-05	0.0000E+00	1.7958E-02	3.4689E-02	4.5498E-02	5.6799E-02	1.1920E-02	4.3182E-03	2.0543E-03	
+/-[j]	1.7182E-07	NA	2.0556E-03	3.4827E-03	4.5317E-03	4.5339E-03	1.0911E-03	1.2579E-03	2.0543E-03	
Segment Total										1.7328E-01
+/-[n]										8.0275E-03
Rod Total										3.5044E-01
+/-[n]										9.7016E-03
shear gas (g)[e]	0	0	0.0002	0.0009	0.0014	0.0017	0.0002	0	0	
+/-[e]	0	0	0	0.0002	0.0003	0.0003	0	0	0	
moles Kr (diss+pl)[d]	0.000001	0	0.000428	0.000826	0.001083	0.001352	0.000284	0.000103	0.000049	
+/-[d]	0	0	0.000049	0.000083	0.000108	0.000108	0.000026	0.00003	0.000049	
Kr+Xe diss&pl (g)[d]	0.0005	0	0.2427	0.5243	0.6734	0.819	0.1758	0.0547	0.0143	
+/-[d]	0	0	0.0085	[illegible]	[illegible]	0.0375	0.018	[illegible]	0.011	
moles kr (tot)[o]	1.0000E-06	0	4.2835E-04	8.2742E-04	1.0853E-03	1.3548E-03	2.8432E-04	1.0300E-04	4.9000E-05	
+/-[p]	0.0000E+00	NA	4.9000E-05	8.3001E-05	1.0800E-04	1.0800E-04	2.6000E-05	3.0000E-05	4.9000E-05	
Xe-128 (mol%)[d]	0	0	0	0	0	0	0	0	0	
+/-[d]	0	0	0	0	0	0	0	0	0	
Xe-128 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[j]	NA	NA	NA	NA	NA	NA	NA	NA	NA	
SegmentTotal										0.0000E+00
+/-[n]										NA

Rod "F" 2400408 (PFB III-6 C13)

	F-00	F-01	F-02	F-03	F-04	F-05	F-06	F-07	F-08	F-09
seg length (in)[a]	11.283	11.575	14.019	14	14	14.198	14.003	10.499	12.917	1.642
total length (in)										1.1814E+02
Xe-130 (mol%)[d]	0	0	0	0	0	0	0	0	0	
+/-[d]	0	0	0	0	0	0	0	0	0	
Xe-130 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[j]	NA	NA	NA	NA	NA	NA	NA	NA	NA	
SegmentTotal										0.0000E+00
+/-[n]										NA
Xe-131 (mol%)[d]	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	12.9	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	5.0660E-05	0.0000E+00	2.5976E-02	5.7260E-02	7.3322E-02	8.8789E-02	1.9121E-02	5.7753E-03	1.2834E-03	
+/-[j]	3.9272E-07	NA	9.5035E-04	5.5903E-03	5.5177E-03	4.6112E-03	1.4598E-03	1.2842E-03	1.2834E-03	
SegmentTotal										2.7156E-01
+/-[n]										9.4494E-03
Xe-132 (mol%)[d]	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	22.1	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-132 (g)[k]	8.7452E-05	0.0000E+00	4.4842E-02	9.8845E-02	1.2657E-01	1.5327E-01	3.3007E-02	9.9696E-03	2.2155E-03	
+/-[j]	7.9142E-07	NA	1.6539E-03	9.6614E-03	9.5432E-03	7.9922E-03	2.5247E-03	2.2173E-03	2.2156E-03	
SegmentTotal										4.6881E-01
+/-[n]										1.6347E-02
Xe-134 (mol%)[d]	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	26.2	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-134 (g)[k]	1.0525E-04	0.0000E+00	5.3967E-02	1.1896E-01	1.5233E-01	1.8446E-01	3.9724E-02	1.1998E-02	2.6663E-03	
+/-[j]	4.0172E-07	NA	1.9405E-03	1.1586E-02	1.1417E-02	9.4989E-03	3.0210E-03	2.6667E-03	2.6663E-03	
SegmentTotal										5.6422E-01
+/-[n]										1.9543E-02

Rod "F" 2400408 (PFB III-6 C13)

	F-00	F-01	F-02	F-03	F-04	F-05	F-06	F-07	F-08	F-09
seg length (in)[a]	11.283	11.575	14.019	14	14	14.198	14.003	10.499	12.917	1.642
total length (in)										1.1814E+02
Xe-136 (mol%)[d]	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	38.8	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-136 (g)[k]	1.5820E-04	0.0000E+00	8.1116E-02	1.7880E-01	2.2896E-01	2.7726E-01	5.9708E-02	1.8034E-02	4.0076E-03	
+/-[j]	8.1544E-07	NA	2.9302E-03	1.7426E-02	1.7179E-02	1.4310E-02	4.5454E-03	4.0087E-03	4.0077E-03	
SegmentTotal										8.4805E-01
+/-[n]										2.9410E-02
Rod total										2.1527E+00
+/-[n]										4.0042E-02
shear gas (g)[e]	0	0	0.0002	0.0009	0.0014	0.0017	0.0002	0	0	
+/-[e]	0	0	0	0.0002	0.0003	0.0003	0	0	0	
moles Xe (diss+pl)[d]	0.000003	0	0.001537	0.003385	0.004333	0.005247	0.001131	0.000342	0.000076	
+/-[d]	0	0	0.000055	0.00033	0.000325	0.00027	0.000086	0.000076	0.000076	
Kr+Xe diss&pl (g)[d]	0.0005	0	0.2427	0.5243	0.6734	0.819	0.1758	0.0547	0.0143	
+/-[d]	0	0	0.0085	0.0449	0.0446	0.0375	0.0118	0.0105	0.011	
moles Xe (tot)[o]	3.0000E-06	0	1.5383E-03	3.3908E-03	4.3420E-03	5.2579E-03	1.1323E-03	3.4200E-04	7.6000E-05	
+/-[p]	0.0000E+00	0	5.5000E-05	3.3000E-04	3.2501E-04	2.7001E-04	8.6000E-05	7.6000E-05	7.6000E-05	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project										
Cs-137 (atoms)[f]	NA	1.5000E+18	2.3740E+20	5.2670E+20	6.9990E+20	7.7010E+20	1.7460E+20	5.8670E+19	9.6820E+18	
+/-[f]	NA	5.0790E+15	8.0300E+17	1.7800E+18	2.2890E+18	2.4290E+18	5.9030E+17	1.9210E+17	3.0540E+16	
Cs-137 (g)[m]	NA	3.4097E-04	5.3964E-02	1.1973E-01	1.5910E-01	1.7505E-01	3.9689E-02	1.3337E-02	2.2009E-03	
+/-[m]	NA	1.1545E-06	1.8253E-04	4.0462E-04	5.2032E-04	5.5215E-04	1.3418E-04	4.3667E-05	6.9422E-06	
Total										5.6341E-01
+/-[n]										8.9028E-04
Ce-144 (atoms)[g]	NA	1.9660E+17	1.6810E+19	2.9810E+19	3.7130E+19	3.9680E+19	1.2010E+19	3.4880E+18	5.0220E+17	
+/-[g]	NA	1.3690E+15	1.1710E+17	2.1490E+17	2.6320E+17	2.7630E+17	8.5140E+16	2.3980E+16	3.4980E+15	
Ce-144 (g)[m]	NA	4.6977E-05	4.0167E-03	7.1230E-03	8.8721E-03	9.4814E-03	2.8698E-03	8.3345E-04	1.2000E-04	
+/-[m]	NA	3.2712E-07	2.7981E-05	5.1350E-05	6.2891E-05	6.6021E-05	2.0344E-05	5.7300E-06	8.3584E-07	
Total										3.3364E-02
+/-[n]										1.1037E-04

Rod "F" 2400408 (PFB III-6 C13)

	F-00	F-01	F-02	F-03	F-04	F-05	F-06	F-07	F-08	F-09
seg length (in)[a]	11.283	11.575	14.019	14	14	14.198	14.003	10.499	12.917	1.642
total length (in)										1.1814E+02
Zr-95 (atoms)[b]	NA	1.9980E+15	1.4220E+17	2.5240E+17	2.7950E+17	2.8920E+17	6.9420E+16	1.1080E+16	1.0730E+15	
+/-[h]	NA	3.9780E+13	2.0000E+15	7.2930E+15	9.0260E+15	9.3340E+15	2.8510E+15	3.0320E+14	4.9140E+13	
Zr-95 (g)[m]	NA	3.1485E-07	2.2408E-05	3.9773E-05	4.4044E-05	4.5572E-05	1.0939E-05	1.7460E-06	1.6908E-07	
+/-[m]	NA	6.2686E-09	3.1516E-07	1.1492E-06	1.4223E-06	1.4709E-06	4.4926E-07	4.7779E-08	7.7435E-09	
Total										1.6497E-04
+/-[n]										2.4105E-06

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod F, 2400408, page 3
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod F, 2400408, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod F, 2400408, page 7
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod F, 2400408, page 10
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod F, 2400408, page 11
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod F, 2400408, page 12
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod F, 2400408, page 13
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod F, 2400408, page 14
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(\mathrm{SUM}(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation =$((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "G" 2300711 (PFB III-6 D29)

	G-00	G-01	G-02	G-03	G-04	G-05	G-06	G-07	G-08
seg length (in)[a]	11.163	8.374	17.971	17.501	17.499	17.601	10.499	14.913	2.635
total length (in)									1.1816E+02
U-238 wt%[b]	0	0.0303	0.2667	0.2613	0.2592	0.2689	0.0054	0.0101	
+/-[b]	0	0.011	0.003	0.0032	0.0031	0.0032	0.0073	0.006	
U-238 g[j]	0.0000E+00	8.3546E-05	3.3605E-02	3.0122E-02	2.9226E-02	2.9896E-02	1.1173E-04	9.9194E-05	
+/-[j]	NA	3.0330E-05	3.7810E-04	3.6896E-04	3.4961E-04	3.5586E-04	1.5104E-04	5.8927E-05	
Segment Total									1.2314E-01
+/-[n]									7.4509E-04
tot U[c]	0.00011	0.27573	12.60037	11.52779	11.27561	11.11803	2.06903	0.98212	
+/-[c]	0.00001	0.0001	0.00312	0.00283	0.00267	0.00287	0.00049	0.00021	
Kr-82 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	0	
Kr-82 (g)[k]	4.0957E-07	0.0000E+00	1.0021E-04	1.7297E-04	2.1641E-04	1.8871E-04	1.4863E-05	4.6539E-06	
+/-[j]	0.0000E+00	NA	1.8135E-05	1.8038E-05	2.0476E-05	2.0229E-05	2.9419E-06	4.5222E-06	
Segment Total									6.9823E-04
+/-[n]									3.8883E-05
Kr-83 (mol%)[d]	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-83 (g)[k]	6.4673E-05	0.0000E+00	1.5824E-02	2.7313E-02	3.4173E-02	2.9799E-02	2.3469E-03	7.3487E-04	
+/-[j]	4.1457E-07	NA	2.8733E-03	2.8640E-03	3.2542E-03	3.2136E-03	4.6593E-04	7.2449E-04	
Segment Total									1.1025E-01
+/-[n]									6.1739E-03
Kr-84 (mol%)[d]	29.9	29.9	29.9	29.9	29.9	29.9	29.9	29.9	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-84 (g)[k]	1.2545E-04	0.0000E+00	3.0693E-02	5.2980E-02	6.6286E-02	5.7801E-02	4.5524E-03	1.4255E-03	
+/-[j]	8.3912E-07	NA	5.5737E-03	5.5563E-03	6.3134E-03	6.2345E-03	9.0381E-04	1.4053E-03	
Segment Total									2.1386E-01
+/-[n]									1.1977E-02

Rod "G" 2300711 (PFB III-6 D29)

	G-00	G-01	G-02	G-03	G-04	G-05	G-06	G-07	G-08
seg length (in)[a]	11.163	8.374	17.971	17.501	17.499	17.601	10.499	14.913	2.635
total length (in)									1.1816E+02
Kr-85 (mol%)[d]	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	2.5049E-05	0.0000E+00	6.1288E-03	1.0579E-02	1.3236E-02	1.1542E-02	9.0901E-04	2.8463E-04	
+/-[j]	4.2456E-07	NA	1.1170E-03	1.1216E-03	1.2774E-03	1.2578E-03	1.8103E-04	2.8064E-04	
Segment Total									4.2704E-02
+/-[n]									2.4148E-03
Kr-86 (mol%)[d]	48.7	48.7	48.7	48.7	48.7	48.7	48.7	48.7	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-86 (g)[k]	2.0919E-04	0.0000E+00	5.1183E-02	8.8348E-02	1.1054E-01	9.6387E-02	7.5914E-03	2.3770E-03	
+/-[j]	8.5911E-07	NA	9.2906E-03	9.2538E-03	1.0512E-02	1.0384E-02	1.5066E-03	2.3434E-03	
Segment Total									3.5663E-01
+/-[n]									1.9951E-02
Rod Total									7.2415E-01
+/-[n]									2.4196E-02
shear gas (g)[e]	0	0	0.0018	0.0047	0.0062	0.0058	0.0003	0.0004	
+/-[e]	0	0.0003	0.0004	[illegible]	[illegible]	[illegible]	0.0003	[illegible]	
moles Kr (diss+pl)[d]	0.000005	0	0.00122	0.002104	0.002631	0.002294	0.000181	0.000056	
+/-[d]	0	0	0.000222	0.000221	0.000251	0.000248	0.000036	0.000056	
Kr+Xe diss&pl (g)[d]	0.003	0	0.6543	1.2938	1.4851	1.3601	0.1222	0.0275	
+/-[d]	0.0001	0	0.0554	0.1499	0.1696	0.1678	0.0197	0.0123	
moles kr (tot)[o]	5.0000E-06	0	1.2234E-03	2.1116E-03	2.6420E-03	2.3038E-03	1.8144E-04	5.6815E-05	
+/-[p]	0.0000E+00	0.0000E+00	2.2200E-04	2.2101E-04	2.5101E-04	2.4801E-04	3.6003E-05	5.6010E-05	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	0	
Xe-128 (g)[k]	2.4302E-06	0.0000E+00	5.2610E-04	1.0664E-03	1.2071E-03	1.1151E-03	1.0206E-04	2.1930E-05	
+/-[j]	1.2790E-07	NA	4.9628E-05	1.4172E-04	1.6027E-04	1.5861E-04	1.8548E-05	1.0749E-05	
SegmentTotal									4.0410E-03
+/-[n]									2.7175E-04

Rod "G" 2300711 (PFB III-6 D29)

	G-00	G-01	G-02	G-03	G-04	G-05	G-06	G-07	G-08
seg length (in)[a]	11.163	8.374	17.971	17.501	17.499	17.601	10.499	14.913	2.635
total length (in)									1.1816E+02
Xe-130 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	0	
Xe-130 (g)[k]	2.4682E-06	0.0000E+00	5.3433E-04	1.0830E-03	1.2259E-03	1.1325E-03	1.0366E-04	2.2273E-05	
+/-[j]	1.2990E-07	NA	5.0404E-05	1.4394E-04	1.6277E-04	1.6109E-04	1.8838E-05	1.0917E-05	
SegmentTotal									4.1042E-03
+/-[n]									2.7600E-04
Xe-131 (mol%)[d]	11.7	11.7	11.7	11.7	11.7	11.7	11.7	11.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	2.9100E-04	0.0000E+00	6.2999E-02	1.2769E-01	1.4454E-01	1.3352E-01	1.2221E-02	2.6260E-03	
+/-[j]	1.5517E-05	NA	5.9671E-03	1.7005E-02	1.9231E-02	1.9027E-02	2.2235E-03	1.2873E-03	
SegmentTotal									4.8389E-01
+/-[n]									3.2607E-02
Xe-132 (mol%)[d]	22.4	22.4	22.4	22.4	22.4	22.4	22.4	22.4	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	5.6138E-04	0.0000E+00	1.2153E-01	2.4633E-01	2.7884E-01	2.5759E-01	2.3577E-02	5.0660E-03	
+/-[j]	2.9653E-05	NA	1.1477E-02	3.2757E-02	3.7044E-02	3.6657E-02	4.2860E-03	2.4831E-03	
SegmentTotal									9.3350E-01
+/-[n]									6.2811E-02
Xe-134 (mol%)[d]	25.4	25.4	25.4	25.4	25.4	25.4	25.4	25.4	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-134 (g)[k]	6.4623E-04	0.0000E+00	1.3990E-01	2.8356E-01	3.2098E-01	2.9652E-01	2.7140E-02	5.8316E-03	
+/-[j]	3.4107E-05	NA	1.3208E-02	3.7703E-02	4.2637E-02	4.2192E-02	4.9334E-03	2.8583E-03	
SegmentTotal									1.0746E+00
+/-[n]									7.2295E-02

Rod "G" 2300711 (PFB III-6 D29)

	G-00	G-01	G-02	G-03	G-04	G-05	G-06	G-07	G-08
seg length (in)[a]	11.163	8.374	17.971	17.501	17.499	17.601	10.499	14.913	2.635
total length (in)									1.1816E+02
Xe-136 (mol%)[d]	40.3	40.3	40.3	40.3	40.3	40.3	40.3	40.3	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-136 (g)[k]	1.0406E-03	0.0000E+00	2.2529E-01	4.5663E-01	5.1688E-01	4.7749E-01	4.3704E-02	9.3909E-03	
+/-[j]	5.4831E-05	NA	2.1259E-02	6.0698E-02	6.8642E-02	6.7928E-02	7.9432E-03	4.6028E-03	
SegmentTotal									1.7304E+00
+/-[n]									1.1639E-01
Rod total									4.2305E+00
+/-[n]									1.5421E-01
shear gas (g)[e]	0	0	0.0018	0.0047	0.0062	0.0058	0.0003	0.0004	
+/-[e]	0	0.0003	0.0004	0.0009	0.0012	0.0012	0.0003	0.0003	
moles Xe (diss+pl)[d]	0.000019	0	0.004102	0.008307	0.009398	0.008681	0.000796	0.000169	
+/-[d]	0.000001	0	0.000388	0.001108	0.001253	0.00124	0.000145	0.000084	
Kr+Xe diss&pl (g)[d]	0.003	0	0.6543	1.2938	1.4851	1.3601	0.1222	0.0275	
+/-[d]	0.0001	0	0.0554	0.1499	0.1696	0.1678	0.0197	0.0123	
moles Xe (tot)[o]	1.9000E-05	0	4.1133E-03	8.3372E-03	9.4372E-03	8.7180E-03	7.9795E-04	1.7146E-04	
+/-[p]	1.0000E-06	0.0000E+00	3.8801E-04	1.1080E-03	1.2530E-03	1.2400E-03	1.4501E-04	8.4036E-05	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project									
Cs-137 (atoms)[f]	NA	2.8440E+18	6.5460E+20	1.3660E+21	1.6500E+21	1.4930E+21	1.1120E+20	2.1190E+19	
+/-[f]	NA	9.8480E+15	1.9110E+18	3.9930E+18	4.8160E+18	4.5460E+18	3.7420E+17	6.1970E+16	
Cs-137 (g)[m]	NA	6.4648E-04	1.4880E-01	3.1051E-01	3.7507E-01	3.3938E-01	2.5277E-02	4.8168E-03	
+/-[m]	NA	2.2386E-06	4.3440E-04	9.0767E-04	1.0947E-03	1.0334E-03	8.5061E-05	1.4087E-05	
Total									1.2045E+00
+/-[n]									1.8128E-03
Ce-144 (atoms)[g]	NA	3.5770E+17	4.1750E+19	6.8620E+19	7.9890E+19	6.5190E+19	6.4820E+18	1.0930E+18	
+/-[g]	NA	2.1040E+15	2.3860E+17	3.9230E+17	4.5650E+17	3.8240E+17	4.0190E+16	6.2480E+15	
Ce-144 (g)[m]	NA	8.5472E-05	9.9761E-03	1.6397E-02	1.9090E-02	1.5577E-02	1.5489E-03	2.6117E-04	
+/-[m]	NA	5.0275E-07	5.7013E-05	9.3739E-05	1.0908E-04	9.1374E-05	9.6033E-06	1.4929E-06	
Total									6.2935E-02
+/-[n]									1.7994E-04

Rod "G" 2300711 (PFB III-6 D29)

	G-00	G-01	G-02	G-03	G-04	G-05	G-06	G-07	G-08
seg length (in)[a]	11.163	8.374	17.971	17.501	17.499	17.601	10.499	14.913	2.635
total length (in)									1.1816E+02
Zr-95 (atoms)[h]	NA	3.8060E+15	3.5190E+17	5.4050E+17	5.7580E+17	3.5670E+17	2.0890E+16	2.5260E+15	
+/-[h]	NA	9.7270E+13	9.3530E+15	1.7500E+16	1.5930E+16	1.4870E+16	8.6540E+14	1.5380E+14	
Zr-95 (g)[m]	NA	5.9975E-07	5.5453E-05	8.5173E-05	9.0735E-05	5.6209E-05	3.2919E-06	3.9805E-07	
+/-[m]	NA	1.5328E-08	1.4739E-06	2.7577E-06	2.5103E-06	2.3432E-06	1.3637E-07	2.4236E-08	
Total									2.9186E-04
+/-[n]									4.6463E-06

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod G, 2300711, page 3
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod G, 2300711, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod G, 2300711, page 7
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod G, 2300711, page 10
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod G, 2300711, page 11
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod G, 2300711, page 12
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod G, 2300711, page 13
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod G, 2300711, page 14
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "H" 3211456 (RIV-3 B1)

	H-00	H-01	H-02	H-03	H-04	H-05	H-06	H-07	H-08	H-09	H-10	H-11	H-12	H-13	H-14	H-15	H-16
seg length (in)[a]	6.262	6.434	6.99	6.954	6.99	6.989	6.962	6.982	6.97	6.982	6.949	7.011	6.963	6.979	6.997	6.046	1.713
total length (in)																	1.1117E+02
U-232 wt%[b]	0	0.0031	0.0184	0.0432	0.0691	0.0958	0.1125	0.1259	0.129	0.1266	0.1197	0.101	0.0794	0.0494	0.0211	0.0042	
+/-[b]	0	0.0001	0.0006	0.0013	0.0021	0.003	0.0035	0.0039	0.004	0.0039	0.0037	0.0031	0.0025	0.0015	0.0007	0.0001	
U-232 g[f]	0.0000E+00	5.2142E-06	1.3360E-04	6.7697E-04	1.6291E-03	3.0159E-03	4.0274E-03	4.8931E-03	5.0960E-03	4.9242E-03	4.5181E-03	3.4419E-03	2.1571E-03	9.3695E-04	2.0435E-04	1.1024E-05	
+/-[f]	NA	1.6822E-07	4.3565E-06	2.0372E-05	4.9510E-05	9.4446E-05	1.2530E-04	1.5158E-04	1.5806E-04	1.5170E-04	1.3966E-04	1.0565E-04	6.7919E-05	2.8451E-05	6.7793E-06	2.6250E-07	
Segment Total																	3.5671E-02
+/-[g]																	3.6689E-04
U-233 wt%[b]	100	99.6564	99.0447	97.9966	96.8945	95.5857	94.7745	94.2144	94.0063	94.1914	94.3476	95.0824	96.2119	97.5042	98.7513	99.5256	
+/-[b]	0	0.0412	0.0122	0.0083	0.007	0.0072	0.0078	0.0081	0.0079	0.0081	0.0077	0.0084	0.0089	0.0089	0.0087	0.0256	
U-233 g[f]	4.0000E-05	1.6762E-01	7.1912E-01	1.5357E+00	2.2844E+00	3.0092E+00	3.3929E+00	3.6616E+00	3.7136E+00	3.6636E+00	3.5611E+00	3.2403E+00	2.6138E+00	1.8493E+00	9.5637E-01	2.6122E-01	
+/-[f]	1.0000E-05	1.1334E-04	1.9025E-04	3.4856E-04	5.3941E-04	5.9894E-04	7.1107E-04	7.9081E-04	2.8468E-03	7.6212E-04	7.4755E-04	7.0710E-04	5.8179E-04	4.7012E-04	2.0568E-04	1.2608E-04	
Segment Total																	3.4630E+01
+/-[g]																	3.5131E-03
U-234 wt%[b]	0	0.2609	0.8942	1.8737	2.8474	3.9693	4.6345	5.0898	5.2635	5.1124	4.9977	4.4001	3.4468	2.3203	1.183	0.3852	
+/-[b]	0	0.0006	0.0006	0.0006	0.0006	0.0007	0.0007	0.0008	0.0008	0.0008	0.0007	0.0007	0.0007	0.0006	0.0006	0.0006	
U-234 g[f]	0.0000E+00	4.3883E-04	6.4924E-03	2.9362E-02	6.7129E-02	1.2496E-01	1.6591E-01	1.9781E-01	2.0793E-01	1.9885E-01	1.8864E-01	1.4995E-01	9.3640E-02	4.4008E-02	1.1457E-02	1.0110E-03	
+/-[f]	NA	1.0362E-06	4.6140E-06	1.1253E-05	2.0684E-05	3.1869E-05	4.0627E-05	5.0027E-05	1.6155E-04	4.9778E-05	4.5046E-05	3.8266E-05	2.6852E-05	1.5444E-05	6.2303E-06	1.6212E-06	
Segment Total																	1.4876E+00
+/-[g]																	1.9782E-04
U-235 wt%[b]	0	0.0039	0.0185	0.0766	0.1783	0.334	0.456	0.5438	0.5738	0.5438	0.511	0.3987	0.2493	0.1149	0.0304	0.0256	
+/-[b]	0	0.0305	0.0092	0.0063	0.0052	0.0052	0.0056	0.0057	0.0055	0.0057	0.0054	0.0062	0.0066	0.0067	0.0066	0.019	
U-235 g[f]	0.0000E+00	6.5598E-06	1.3432E-04	1.2004E-03	4.2035E-03	1.0515E-02	1.6396E-02	2.1135E-02	2.2667E-02	2.1151E-02	1.9288E-02	1.3587E-02	6.7728E-03	2.1793E-03	2.9441E-04	6.7192E-05	
+/-[f]	NA	5.1301E-05	6.6798E-05	9.8725E-05	1.2260E-04	1.6371E-04	2.0050E-04	2.2157E-04	2.1796E-04	2.2174E-04	2.0386E-04	2.1130E-04	1.7931E-04	1.2708E-04	6.3918E-05	4.9869E-05	
Segment Total																	1.3960E-01
+/-[g]																	6.2106E-04
U-236 wt%[b]	0	0.0014	0.0003	0.0012	0.0042	0.01	0.0159	0.0214	0.0229	0.0212	0.0193	0.013	0.0065	0.0025	0.0006	0.0004	
+/-[b]	0	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	0.0002	
U-236 g[f]	0.0000E+00	2.3548E-06	2.1782E-06	1.8805E-05	9.9018E-05	3.1481E-04	5.6921E-04	8.3170E-04	9.0463E-04	8.2458E-04	7.2847E-04	4.4302E-04	1.7659E-04	4.7417E-05	5.8108E-06	1.0499E-06	
+/-[f]	NA	3.3640E-07	1.4521E-06	3.1341E-06	2.3577E-06	3.1487E-06	3.5816E-06	3.8900E-06	4.0101E-06	3.8929E-06	3.7771E-06	3.4090E-06	2.7169E-06	1.8967E-06	1.9369E-06	5.2494E-07	
Segment Total																	4.9697E-03
+/-[g]																	1.1296E-05
U-238 wt%[b]	[illegible]	[illegible]	[illegible]	[illegible]	0.0065	0.0053	0.0045	0.0046	0.0039	0.0047	0.0048	0.0048	0.0061	0.0088	0.0136	0.059	
+/-[b]	0	0.0278	0.0082	0.0055	0.0045	0.0045	0.0049	0.005	0.0048	0.005	0.0048	0.0054	0.0059	0.006	0.0058	0.0173	
U-238 g[f]	0.0000E+00	1.2514E-04	1.7425E-04	1.3477E-04	1.5324E-04	1.6685E-04	1.6110E-04	1.8655E-04	1.5406E-04	1.8281E-04	1.8118E-04	1.6358E-04	1.6572E-04	1.6691E-04	1.3171E-04	1.5486E-04	
+/-[f]	NA	4.6760E-05	5.9537E-05	8.6188E-05	1.0609E-04	1.4167E-04	1.7542E-04	1.9432E-04	1.8962E-04	1.9448E-04	1.8118E-04	1.8402E-04	1.6029E-04	1.1380E-04	5.6171E-05	4.5407E-05	
Segment Total																	2.4027E-03
+/-[g]																	5.4529E-04
tot U[c]	0.00005	0.1682	0.72606	1.56706	2.35757	3.14813	3.57394	3.89647	3.95037	3.88954	3.77448	3.40785	2.71671	1.89667	0.96846	0.26247	
+/-[c]	0.00001	0.00009	0.00017	0.00033	0.00053	0.00058	0.00069	0.00077	0.00301	0.00076	0.00073	0.00068	0.00055	0.00045	0.00019	0.0001	
Kr-82 (mol%)[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+/-[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Kr-82 (g)[e]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[f]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total																	0.0000E+00
+/-[g]																	NA

Rod "H" 3211456 (RIV-3 B1)

	H-00	H-01	H-02	H-03	H-04	H-05	H-06	H-07	H-08	H-09	H-10	H-11	H-12	H-13	H-14	H-15	H-16
seg length (in)[a]	6.262	6.434	6.93	6.954	6.99	6.989	6.962	6.982	6.97	6.982	6.949	7.011	6.963	6.979	6.997	6.046	1.713
total length (in)																	1.1117E+02
Kr-83 (mol%)[d]	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-83 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	1.0994E-03	1.8108E-03	3.2382E-03	3.7187E-03	5.8217E-03	6.4289E-03	6.3507E-03	5.0662E-03	5.1437E-03	3.6375E-03	1.3608E-03	3.1043E-04	0.0000E+00	
+/-[l]	NA	NA	NA	3.6244E-04	4.8822E-04	6.4808E-04	5.3248E-04	8.0542E-04	1.4783E-03	7.0320E-04	7.4013E-04	7.4022E-04	1.2167E-03	2.4630E-04	1.5527E-04	NA	
Segment Total																	4.3987E-02
+/-[l]																	2.6528E-03
Kr-84 (mol%)[d]	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	29.3	
+/-[d]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Kr-84 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	2.0898E-03	3.4421E-03	6.1552E-03	7.0684E-03	1.1066E-02	1.2220E-02	1.2071E-02	9.6297E-03	9.7771E-03	6.9142E-03	2.5866E-03	5.9007E-04	0.0000E+00	
+/-[l]	NA	NA	NA	6.8874E-04	8.8589E-04	1.2309E-03	1.0100E-03	1.5296E-03	2.8056E-03	1.3334E-03	1.4049E-03	1.4050E-03	2.3122E-03	4.6789E-04	2.9509E-04	NA	
Segment Total																	8.3611E-02
+/-[l]																	5.0380E-03
Kr-85 (mol%)[d]	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	6.1	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-85 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	4.4027E-04	7.2515E-04	1.2967E-03	1.4891E-03	2.3313E-03	2.6745E-03	2.5432E-03	2.0287E-03	2.0598E-03	1.4567E-03	5.4493E-04	1.2431E-04	0.0000E+00	
+/-[l]	NA	NA	NA	1.4575E-04	1.8798E-04	2.6245E-04	2.1791E-04	3.3011E-04	5.9649E-04	2.9187E-04	3.0264E-04	3.0287E-04	4.8922E-04	1.0002E-04	6.2289E-05	NA	
Segment Total																	1.7615E-02
+/-[l]																	1.0768E-03
Kr-86 (mol%)[d]	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	
+/-[d]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Kr-86 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	3.5828E-03	5.9175E-03	1.0582E-02	1.2152E-02	1.9024E-02	2.1009E-02	2.0753E-02	1.6555E-02	1.6809E-02	1.1887E-02	4.4468E-03	1.0144E-03	0.0000E+00	
+/-[l]	NA	NA	NA	1.1837E-03	1.5221E-03	2.1144E-03	1.7346E-03	2.6232E-03	4.8203E-03	2.2860E-03	2.4114E-03	2.4115E-03	3.9739E-03	8.0356E-04	5.0725E-04	NA	
Segment Total																	1.4374E-01
+/-[l]																	8.6524E-03
Rod Total																	2.8896E-01
+/-[l]																	1.0414E-02
shear gas (g)[e]	0	0	0	0	0	0.0002	0.0003	0.0006	0.0006	0.0006	0.0004	0.0003	0.0001	0.0001	0	0	
+/-[e]	0	0	0	0	0	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0	0	0	0	
moles Kr (diss+pl)[d]	0	0	0	0.000085	0.00014	0.00025	0.000287	0.000449	0.000496	0.00049	0.000391	0.000397	0.000281	0.000105	0.000024	0	
+/-[d]	0	0	0	0.000028	0.000036	0.00005	0.000041	0.000062	0.000114	0.000054	0.000057	0.000057	0.000094	0.000019	0.000012	0	
kr+Xe diss&pl (g)[d]	0.0001	0	0	0.0476	0.073	0.1419	0.1729	0.2471	0.288	0.2973	0.232	0.1782	0.1244	0.051	0.0141	0	
+/-[d]	0	0	0	0.0068	0.007	0.0141	0.0169	0.0342	0.0372	0.0296	0.0137	0.016	0.0149	0.006	0.0042	0	
moles kr (tot)[p]	0	0	0	8.5000E-05	1.4000E-04	2.5035E-04	2.8750E-04	4.5089E-04	4.9703E-04	4.9093E-04	3.9167E-04	3.9767E-04	2.8123E-04	1.0521E-04	2.4000E-05	0	
+/-[p]	0	0	0	2.8000E-05	3.6000E-05	5.0000E-05	4.1000E-05	6.2001E-05	1.1400E-04	5.4000E-05	5.7000E-05	5.7001E-05	9.4000E-05	1.9000E-05	1.2000E-05	0	
Xe-128 (mol%)[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+/-[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Xe-128 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[l]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
SegmentTotal																	0.0000E+00
+/-[l]																	NA

Rod "H" 3211456 (R IV-3 B1)

	H-00	H-01	H-02	H-03	H-04	H-05	H-06	H-07	H-08	H-09	H-10	H-11	H-12	H-13	H-14	H-15	H-16
seg length (in)[a]	6.252	6.434	6.99	6.954	6.99	6.989	5.962	6.982	6.97	6.982	6.949	7.011	6.963	6.979	6.997	6.046	1.713
total length (in)																	1.1117E+02
Xe-130 (mol%)[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
+/-[d]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Xe-130 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[l]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
SegmentTotal																	0.0000E+00
+/-[l]																	NA
Xe-131 (mol%)[d]	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	12.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	1.6625E-05	0.0000E+00	0.0000E+00	5.0041E-03	7.5644E-03	1.4967E-02	1.8419E-02	2.5965E-02	3.0504E-02	3.1734E-02	2.4564E-02	1.7919E-02	1.2462E-02	5.2305E-03	1.4962E-03	0.0000E+00	
+/-[l]	1.3091E-07	NA	NA	7.8237E-04	7.8364E-04	1.6667E-03	2.0500E-03	3.5968E-03	4.4454E-03	3.6329E-03	1.5913E-03	1.8839E-03	1.5658E-03	7.1606E-04	4.9889E-04	NA	
SegmentTotal																	1.9595E-01
+/-[l]																	7.9623E-03
Xe-132 (mol%)[d]	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	21.2	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-132 (g)[k]	2.7964E-05	0.0000E+00	0.0000E+00	8.4171E-03	1.2723E-02	2.5175E-02	3.0981E-02	4.3673E-02	6.1308E-02	5.3378E-02	4.1486E-02	3.0140E-02	2.0962E-02	8.7978E-03	2.5167E-03	0.0000E+00	
+/-[l]	2.6381E-07	NA	NA	1.3167E-03	1.3198E-03	2.8064E-03	3.4520E-03	6.0543E-03	7.4820E-03	6.1169E-03	2.6853E-03	3.1727E-03	2.6360E-03	1.2053E-03	8.3325E-04	NA	
SegmentTotal																	3.2959E-01
+/-[l]																	1.3405E-02
Xe-134 (mol%)[d]	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	26.1	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-134 (g)[k]	3.4949E-05	0.0000E+00	0.0000E+00	1.0520E-02	1.5902E-02	3.1464E-02	3.8721E-02	5.4583E-02	6.4125E-02	6.6713E-02	5.1849E-02	3.7669E-02	2.6198E-02	1.0996E-02	3.1454E-03	0.0000E+00	
+/-[l]	2.6781E-07	NA	NA	1.6446E-03	1.6471E-03	3.5032E-03	4.3091E-03	7.5607E-03	9.3445E-03	7.6361E-03	3.3440E-03	3.9599E-03	3.2914E-03	1.5052E-03	1.0488E-03	NA	
SegmentTotal																	4.1192E-01
+/-[l]																	1.6737E-02
Xe-136 (mol%)[d]	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	40.1	
+/-[d]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Xe-136 (g)[k]	5.4499E-05	0.0000E+00	0.0000E+00	1.6404E-02	2.4797E-02	4.9063E-02	6.0380E-02	8.5115E-02	9.9995E-02	1.0403E-01	8.0852E-02	5.8739E-02	4.0852E-02	1.7146E-02	4.9049E-03	0.0000E+00	
+/-[l]	4.0772E-07	NA	NA	2.5844E-03	2.5682E-03	5.4622E-03	6.7187E-03	1.1789E-02	1.4570E-02	1.1906E-02	5.2127E-03	6.1741E-03	5.1320E-03	2.3470E-03	1.6354E-03	NA	
SegmentTotal																	6.4233E-01
+/-[l]																	2.6096E-02
Rod total																	1.5788E+00
+/-[l]																	3.4702E-02
shear gas (g)[e]	0	0	0	0	0	0.0002	0.0003	0.0006	0.0008	0.0008	0.0004	0.0003	0.0001	0.0001	0	0	
+/-[e]	0	0	0	0	0	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0	0	0	0	
moles Xe (diss+pl)[d]	0.000001	0	0	0.000301	0.000455	0.000899	0.001106	0.001558	0.001831	0.001905	0.001481	0.001076	0.000749	0.000314	0.00009	0	
+/-[d]	0	0	0	0.000047	0.000047	0.0001	0.000123	0.000216	0.000267	0.000218	0.000095	0.000113	0.000094	0.000043	0.00003	0	
Kr+Xe diss&pl (g)[d]	0.0001	0	0	0.0476	0.073	0.1419	0.1729	0.2471	0.288	0.2973	0.232	0.1782	0.1244	0.051	0.0141	0	
+/-[d]	0	0	0	0.0068	0.007	0.0141	0.0169	0.0342	0.0372	0.0296	0.0137	0.016	0.0149	0.006	0.0042	0	
moles Xe (tot)[o]	1.0000E-06	0	0	3.0100E-04	4.5500E-04	9.0027E-04	1.1079E-03	1.5618E-03	1.8348E-03	1.9088E-03	1.4836E-03	1.0778E-03	7.4968E-04	3.1462E-04	9.0000E-05	0	
+/-[p]	0.0000E+00	0	0	4.7000E-05	4.7000E-05	1.0000E-04	1.2300E-04	2.1600E-04	2.6700E-04	2.1800E-04	9.5002E-05	1.1300E-04	9.4000E-05	4.3000E-05	3.0000E-05	0	

Rod "H" 3211456 (RIV-3 B1)

	H-00	H-01	H-02	H-03	H-04	H-05	H-06	H-07
seg length (in)[a]	6.262	6.434	6.99	6.954	6.99	6.989	6.962	6.982
total length (in)								
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project								
Cs-137 (atoms)[f]	NA	6.7540E+17	8.6150E+18	3.5870E+19	7.9950E+19	1.4820E+20	1.9610E+20	2.3470E+20
+/-[f]	NA	2.3150E+15	2.9540E+16	1.2290E+17	2.7400E+17	4.1590E+17	6.7210E+17	8.0460E+17
Cs-137 (g)[m]	NA	1.5353E-04	1.9583E-03	8.1538E-03	1.8174E-02	3.3688E-02	4.4576E-02	5.3351E-02
+/-[m]	NA	5.2623E-07	6.7149E-06	2.7937E-05	6.2284E-05	9.4540E-05	1.5278E-04	1.8290E-04
Total								
+/-[n]								
Ce-144 (atoms)[g]	NA	8.9130E+16	9.9130E+17	3.6450E+18	7.1910E+18	1.2160E+19	1.5010E+19	1.7580E+19
+/-[g]	NA	5.1610E+14	5.7400E+15	2.1100E+16	4.1630E+16	6.4310E+16	8.6900E+16	1.0180E+17
Ce-144 (g)[m]	NA	2.1297E-05	2.3687E-04	8.7096E-04	1.7183E-03	2.9056E-03	3.5866E-03	4.2007E-03
+/-[m]	NA	1.2332E-07	1.3716E-06	5.0418E-06	9.9474E-06	1.5367E-05	2.0765E-05	2.4326E-05
Total								
+/-[n]								
Zr-95 (atoms)[h]	NA	1.0200E+15	9.4890E+15	3.4230E+16	6.7640E+16	1.0940E+17	1.3220E+17	1.4820E+17
+/-[h]	NA	4.8030E+13	1.3610E+14	6.6370E+14	1.4040E+15	1.7110E+15	1.8940E+15	2.7710E+15
Zr-95 (g)[m]	NA	1.6073E-07	1.4953E-06	5.3940E-06	1.0659E-05	1.7239E-05	2.0832E-05	2.3354E-05
+/-[m]	NA	7.5686E-09	2.1447E-08	1.0459E-07	2.2124E-07	2.6962E-07	2.9846E-07	4.3666E-07
Total								
+/-[n]								

	H-08	H-09	H-10	H-11	H-12	H-13	H-14	H-15	H-16
seg length (in)[a]	6.97	6.982	6.949	7.011	6.963	6.979	5.997	6.046	1.713
total length (in)									1.1117E+02
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project									
Cs-137 (atoms)[f]	2.4780E+20	2.3600E+20	2.2720E+20	1.7930E+20	1.1100E+20	5.2680E+19	1.4520E+19	1.4370E+18	
+/-[f]	7.3060E+17	8.0830E+17	7.7860E+17	5.9440E+17	3.5590E+17	1.7460E+17	4.8100E+16	4.6030E+15	
Cs-137 (g)[m]	5.6328E-02	5.3646E-02	5.1646E-02	4.0757E-02	2.5232E-02	1.1975E-02	3.3006E-03	3.2665E-04	
+/-[m]	1.6608E-04	1.8374E-04	1.7699E-04	1.3512E-04	8.0901E-05	3.9689E-05	1.0934E-05	1.0463E-06	
Total									4.0327E-01
+/-[n]									4.3543E-04
Ce-144 (atoms)[g]	1.8560E+19	1.7640E+19	1.6420E+19	1.2070E+19	7.0640E+18	3.1610E+18	8.2070E+17	7.5500E+16	
+/-[g]	9.1400E+16	1.0210E+17	9.5060E+16	6.9850E+16	4.0920E+16	1.8770E+16	5.0260E+15	4.3720E+14	
Ce-144 (g)[m]	4.4349E-03	4.2150E-03	3.9235E-03	2.8841E-03	1.6879E-03	7.5531E-04	1.9610E-04	1.8041E-05	
+/-[m]	2.1840E-05	2.4397E-05	2.2714E-05	1.6690E-05	9.7777E-06	4.4850E-06	1.2010E-06	1.0447E-07	
Total									3.1655E-02
+/-[n]									5.8044E-05
Zr-95 (atoms)[h]	1.5450E+17	1.4190E+17	1.2090E+17	6.9950E+16	3.0060E+16	1.0870E+16	1.9730E+15	1.8660E+14	
+/-[h]	2.7120E+15	2.9470E+15	2.5930E+15	1.7180E+15	8.2260E+14	5.4450E+14	7.8820E+13	2.7470E+13	
Zr-95 (g)[m]	2.4346E-05	2.2361E-05	1.9052E-05	1.1023E-05	4.7369E-06	1.7129E-06	3.1091E-07	2.9405E-08	
+/-[m]	4.2736E-07	4.6439E-07	4.0981E-07	2.7072E-07	1.2963E-07	8.5803E-08	1.2421E-08	4.3288E-09	
Total									1.6271E-04
+/-[n]									1.0372E-06

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod H, 3211456, page 4
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod H, 3211456, page 7
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod H, 3211456, page 8
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod H, 3211456, page 11
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod H, 3211456, page 12
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod H, 3211456, page 13
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod H, 3211456, page 14
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod H, 3211456, page 15
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_q)^2)^{1/2}$, where sd is the +/- in the table

Rod "I" 1605519 (SBI-3 E56)

	I-00	I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08	I-09
seg length (in)[a]	11.027	11.202	14.297	14.095	14.098	14.097	14.096	14.198	9.411	1.647
total length (in)										1.1817E+02
U-232 wt%[b]	0	0.0158	0.0358	0.1227	0.1852	0.1947	0.1575	0.06	0.0275	
+/-[b]	0	0.0005	0.0011	0.0038	0.0057	0.006	0.0049	0.0019	0.0009	
U-232 g[i]	0.0000E+00	6.6753E-05	3.3265E-03	1.1649E-02	1.8055E-02	1.8929E-02	1.4799E-02	5.3594E-03	2.1487E-04	
+/-[j]	NA	2.1125E-06	1.0221E-04	3.6078E-04	5.5569E-04	5.8334E-04	4.6044E-04	1.6972E-04	7.0322E-06	
Segment Total										7.2399E-02
+/-[n]										1.0152E-03
U-233 wt%[b]	100	99.061	94.0117	88.9998	86.0057	85.4541	86.8993	91.5377	98.1679	
+/-[b]	0	0.0146	0.0062	0.0063	0.0069	0.0068	0.0069	0.0052	0.008	
U-233 g[i]	4.0000E-05	4.1852E-01	8.7354E+00	8.4494E+00	8.3844E+00	8.3079E+00	8.1654E+00	8.1764E+00	7.6703E-01	
+/-[j]	1.0000E-05	1.3392E-04	2.3014E-03	2.2267E-03	2.1628E-03	2.2281E-03	2.1095E-03	1.9154E-03	1.8743E-04	
Segment Total										5.1405E+01
+/-[n]										5.2980E-03
U-234 wt%[b]	0	0.8865	5.1233	9.0783	11 2823	11.6908	10.6757	7.1544	1.7275	
+/-[b]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0021	
U-234 g[i]	0.0000E+00	3.7454E-03	4.7605E-01	8.6187E-01	1.0999E+00	1.1366E+00	1.0031E+00	6.3905E-01	1.3498E-02	
+/-[j]	NA	8.9358E-06	2.1427E-04	2.8356E-04	3.2714E-04	3.4476E-04	3.0445E-04	2.2337E-04	1.6700E-05	
Segment Total										5.2338E+00
+/-[n]										7.0366E-04
U-235 wt%[b]	0	0.0187	0.5588	1.4793	2.1395	2.255	1.9008	0.9486	0.0672	
+/-[b]	0	0.0103	0.0044	0.004	0.0037	0.0034	0.0041	0.0035	0.0056	
U-235 g[i]	0.0000E+00	7.9006E-05	5.1923E-02	1.4044E-01	2.0857E-01	2.1923E-01	1.7861E-01	8.4732E-02	5.2506E-04	
+/-[j]	NA	4.3516E-05	4.0905E-04	3.8142E-04	3.6431E-04	3.3528E-04	3.8774E-04	3.1322E-04	4.3755E-05	
Segment Total										8.8411E-01
+/-[n]										9.0012E-04
U-236 wt%[b]	0	0	0.037	0.1122	0.1964	0.2143	0.1631	0.0649	0.0011	
+/-[b]	0	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	
U-236 g[i]	0.0000E+00	0.0000E+00	3.4380E-03	1.0652E-02	1.9146E-02	2.0834E-02	1.5325E-02	5.7971E-03	8.5947E-06	
+/-[j]	NA	NA	1.8604E-05	1.9179E-05	2.0054E-05	2.0163E-05	1.9167E-05	1.7913E-05	1.5627E-06	
Segment Total										7.5202E-02
+/-[n]										4.7046E-05

Rod "I" 1605519 (SBI-3 E56)

	I-00	I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08	I-09
seg length (in)[a]	11.027	11.202	14.297	14.095	14.098	14.097	14.096	14.198	9.411	1.647
total length (in)										1.1817E+02
U-238 wt%[b]	0	0.018	0.2334	0.2076	0.191	0.1912	0.2037	0.2344	0.0087	
+/-[b]	0	0.0103	0.0043	0.004	0.0037	0.0034	0.0042	0.0035	0.0055	
U-238 g[i]	0.0000E+00	7.6048E-05	2.1687E-02	1.9709E-02	1.8620E-02	1.8589E-02	1.9140E-02	2.0937E-02	6.7977E-05	
+/-[j]	NA	4.3516E-05	3.9959E-04	3.7978E-04	3.6073E-04	3.3058E-04	3.9468E-04	3.1267E-04	4.2974E-05	
Segment Total										1.1883E-01
+/-[n]										8.9476E-04
tot U[c]	0.00011	0.42249	9.29183	9.49378	9.74871	9.72203	9.39636	8.93231	0.78134	
+/-[c]	0.00001	0.00012	0.00237	0.00241	0.00239	0.00249	0.00231	0.00203	0.00018	
Kr-82 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-82 (g)[k]	9.8296E-07	0.0000E+00	1.3670E-04	2.6405E-04	4.5848E-04	3.5089E-04	3.7442E-04	1.9208E-04	1.0758E-07	
+/-[j]	4.9148E-07	NA	7.0440E-05	1.3417E-04	2.3408E-04	1.7973E-04	1.9106E-04	1.0275E-04	9.9568E-08	
Segment Total										1.7777E-03
+/-[n]										3.9638E-04
Kr-83 (mol%)[d]	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	15.4	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-83 (g)[k]	7.6613E-05	0.0000E+00	1.0654E-02	2.0580E-02	3.5734E-02	2.7349E-02	2.9182E-02	1.4971E-02	8.3846E-06	
+/-[j]	4.9748E-07	NA	1.3298E-03	1.8691E-03	3.6975E-03	3.0442E-03	2.9812E-03	2.8491E-03	6.5308E-06	
Segment Total										1.3856E-01
+/-[n]										6.7235E-03
Kr-84 (mol%)[d]	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	30.2	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-84 (g)[k]	1.5205E-04	0.0000E+00	2.1145E-02	4.0844E-02	7.0919E-02	5.4277E-02	5.7916E-02	2.9711E-02	1.6640E-05	
+/-[j]	1.0069E-06	NA	2.6392E-03	3.7098E-03	7.3388E-03	6.0420E-03	5.9171E-03	5.6546E-03	1.2961E-05	
Segment Total										2.7498E-01
+/-[n]										1.3345E-02

Rod "I" 1605519 (SBI-3 E56)

	I-00	I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08	I-09
seg length (in)[a]	11.027	11.202	14.297	14.095	14.098	14.097	14.096	14.198	9.411	1.647
total length (in)										1.1817E+02
Kr-85 (mol%)[d]	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	2.9550E-05	0.0000E+00	4.1093E-03	7.9377E-03	1.3783E-02	1.0548E-02	1.1256E-02	5.7742E-03	3.2339E-06	
+/-[j]	5.0947E-07	NA	5.1707E-04	7.3196E-04	1.4430E-03	1.1862E-03	1.1638E-03	1.1028E-03	2.5194E-06	
Segment Total										5.3441E-02
+/-[n]										2.6197E-03
Kr-86 (mol%)[d]	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-86 (g)[k]	2.5052E-04	0.0000E+00	3.4838E-02	6.7295E-02	1.1685E-01	8.9427E-02	9.5423E-02	4.8953E-02	2.7417E-05	
+/-[j]	1.0309E-06	NA	4.3447E-03	6.1023E-03	1.2076E-02	9.9441E-03	9.7364E-03	9.3131E-03	2.1354E-05	
Segment Total										4.5306E-01
+/-[n]										2.1963E-02
Rod Total										9.2181E-01
+/-[n]										2.6696E-02
shear gas (g)[e]	0	0	0.0009	0.0023	0.0033	0.0033	0.003	0.0021	0.0004	
+/-[e]	0	0.0003	0.0003	0.0005	0.0007	0.0007	0.0006	0.0004	0.0003	
moles Kr (diss+pl)[d]	0.000006	0	0.000833	0.001608	0.002793	0.002137	0.00228	0.001169	0	
+/-[d]	0	0	0.000104	0.000146	0.000289	0.000238	0.000233	0.000223	0	
Kr+Xe diss&pl (g)[d]	0.0033	0	0.5392	0.9869	1.6595	1.4567	1.2554	0.7121	0	
+/-[d]	0.0002	0	0.0228	0.0666	0.1317	[illegible]	0.1265	0.0627	0	
moles kr (tot)[o]	6.0000E-06	0	8.3439E-04	1.6117E-03	2.7986E-03	2.1418E-03	2.2854E-03	1.1724E-03	6.5665E-07	
+/-[p]	0.0000E+00	0.0000E+00	1.0400E-04	1.4600E-04	2.8900E-04	2.3800E-04	2.3300E-04	2.2300E-04	5.1145E-07	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	0	0	
Xe-128 (g)[k]	2.6860E-06	0.0000E+00	4.4713E-04	8.1216E-04	1.3578E-03	1.2177E-03	1.0141E-03	5.8560E-04	3.2798E-07	
+/-[j]	1.2790E-13	NA	1.9955E-05	6.2291E-05	1.2317E-04	1.2151E-04	1.1908E-04	5.6918E-05	2.4973E-07	
SegmentTotal										5.4376E-03
+/-[n]										2.2723E-04

Rod "I" 1605519 (SBI-3 E56)

	I-00	I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08	I-09
seg length (in)[a]	11.027	11.202	14.297	14.095	14.098	14.097	14.096	14.198	9.411	1.647
total length (in)										1.1817E+02
Xe-130 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	0	0	
Xe-130 (g)[k]	2.7280E-06	0.0000E+00	4.5412E-04	8.2486E-04	1.3791E-03	1.2367E-03	1.0300E-03	5.9476E-04	3.3310E-07	
+/-[j]	1.2990E-13	NA	2.0267E-05	6.3265E-05	1.2510E-04	1.2341E-04	1.2094E-04	5.7808E-05	2.5363E-07	
SegmentTotal										5.5226E-03
+/-[n]										2.3079E-04
Xe-131 (mol%)[d]	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	3.1339E-04	0.0000E+00	5.2169E-02	9.4759E-02	1.5843E-01	1.4208E-01	1.1832E-01	6.8325E-02	3.8267E-05	
+/-[j]	2.7490E-06	NA	2.3728E-03	7.3152E-03	1.4438E-02	1.4232E-02	1.3932E-02	6.6680E-03	2.9139E-05	
SegmentTotal										6.3443E-01
+/-[n]										2.6622E-02
Xe-132 (mol%)[d]	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	6.2879E-04	0.0000E+00	1.0467E-01	1.9013E-01	3.1787E-01	2.8507E-01	2.3741E-01	1.3709E-01	7.6779E-05	
+/-[j]	2.7700E-06	NA	4.6941E-03	1.4606E-02	2.8869E-02	2.8473E-02	2.7896E-02	1.3338E-02	5.8462E-05	
SegmentTotal										1.2729E+00
+/-[n]										5.3251E-02
Xe-134 (mol%)[d]	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-134 (g)[k]	7.2550E-04	0.0000E+00	1.2077E-01	2.1937E-01	3.6676E-01	3.2891E-01	2.7392E-01	1.5817E-01	8.8589E-05	
+/-[j]	2.8120E-06	NA	5.4101E-03	1.6847E-02	3.3300E-02	3.2845E-02	3.2182E-02	1.5386E-02	6.7454E-05	
SegmentTotal										1.4687E+00
+/-[n]										6.1426E-02

Rod "I" 1605519 (SBI-3 E56)

	I-00	I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08	I-09
seg length (in)[a]	11.027	11.202	14.297	14.095	14.098	14.097	14.096	14.198	9.411	1.647
total length (in)										1.1817E+02
Xe-136 (mol%)[d]	40	40	40	40	40	40	40	40	40	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-136 (g)[k]	1.1416E-03	0.0000E+00	1.9004E-01	3.4519E-01	5.7712E-01	5.1756E-01	4.3104E-01	2.4890E-01	1.3940E-04	
+/-[j]	2.8541E-06	NA	8.4946E-03	2.6489E-02	5.2372E-02	5.1662E-02	5.0624E-02	2.4200E-02	1.0614E-04	
SegmentTotal										2.3111E+00
+/-[n]										9.6613E-02
Rod total										5.6982E+00
+/-[n]										1.2904E-01
shear gas (g)[e]	0	0	0.0009	0.0023	0.0033	0.0033	0.003	0.0021	0.0004	
+/-[e]	0	0.0003	0.0003	0.0005	0.0007	0.0007	0.0006	0.0004	0.0003	
moles Xe (diss+pl)[d]	0.000021	0	0.00349	0.006335	0.010595	0.009499	0.00791	0.004565	0	
+/-[d]	0.000001	0	0.000156	0.000487	0.000963	0.00095	0.000931	0.000445	0	
Kr+Xe diss&pl (g)[d]	0.0033	0	0.5392	0.9869	1.6595	1.4567	1.2554	0.7121	0	
+/-[d]	0.0002	0	0.0228	0.0666	0.1317	0.1291	0.1265	0.0627	0	
moles Xe (tot)[o]	2.1000E-05	0	3.4958E-03	6.3498E-03	1.0616E-02	9.5205E-03	7.9289E-03	4.5785E-03	2.5642E-06	
+/-[p]	1.0000E-12	0.0000E+00	1.5601E-04	4.8701E-04	9.6301E-04	9.5002E-04	9.3101E-04	4.4501E-04	1.9525E-06	

Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project

	I-00	I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08	I-09
Cs-137 (atoms)[f]	ND	4.7130E+18	4.8210E+20	1.0350E+21	1.3880E+21	1.4450E+21	1.2550E+21	7.2630E+20	1.6160E+19	
+/-[f]	NA	2.0920E+16	2.1300E+18	4.5800E+18	6.1340E+18	6.1360E+18	5.3250E+18	3.2110E+18	6.9020E+16	
Cs-137 (g)[m]	NA	1.0713E-03	1.0959E-01	2.3527E-01	3.1551E-01	3.2847E-01	2.8528E-01	1.6510E-01	3.6734E-03	
+/-[m]	NA	4.7554E-06	4.8418E-04	1.0411E-03	1.3943E-03	1.3948E-03	1.2104E-03	7.2991E-04	1.5689E-05	
Total										1.4440E+00
+/-[n]										2.6844E-03
Ce-144 (atoms)[g]	ND	5.9550E+17	3.2600E+19	5.5100E+19	6.8020E+19	7.1360E+19	5.5720E+19	2.7200E+19	7.6490E+17	
+/-[g]	NA	3.7660E+15	2.2010E+17	3.8120E+17	4.5920E+17	4.6020E+17	3.6670E+17	1.8810E+17	4.8400E+15	
Ce-144 (g)[m]	NA	1.4229E-04	7.7887E-03	1.3166E-02	1.6253E-02	1.7051E-02	1.3314E-02	6.4994E-03	1.8277E-04	
+/-[m]	NA	8.9988E-07	5.2592E-05	9.1087E-05	1.0972E-04	1.0996E-04	8.7622E-05	4.4946E-05	1.1565E-06	
Total										7.4399E-02
+/-[n]										2.1188E-04

Rod "I" 1605519 (SBI-3 E56)

	I-00	I-01	I-02	I-03	I-04	I-05	I-06	I-07	I-08	I-09
seg length (in)[a]	11.027	11.202	14.297	14.095	14.098	14.097	14.096	14.198	9.411	1.647
total length (in)										1.1817E+02
Zr-95 (atoms)[h]	ND	6.5160E+15	2.6370E+17	4.4440E+17	5.2800E+17	5.3660E+17	2.6590E+17	7.1580E+16	1.4500E+15	
+/-[h]	NA	1.3700E+14	1.0230E+16	1.9070E+16	1.9940E+16	2.6800E+16	1.6250E+16	8.7200E+15	1.0190E+14	
Zr-95 (g)[m]	NA	1.0268E-06	4.1554E-05	7.0029E-05	8.3203E-05	8.4558E-05	4.1901E-05	1.1280E-05	2.2849E-07	
+/-[m]	NA	2.1589E-08	1.6121E-06	3.0051E-06	3.1422E-06	4.2232E-06	2.5607E-06	1.3741E-06	1.6058E-08	
Total										3.3378E-04
+/-[n]										6.9126E-06

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod I, 1605519, page 3
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod I, 1605519, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod I, 1605519, page 7
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod I, 1605519, page 10
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod I, 1605519, page 11
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod I, 1605519, page 12
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod I, 1605519, page 13
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod I, 1605519, page 14
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0226E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pi))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "J" 1200830 (SBI-3 A49)

	J-00	J-01	J-02	J-03	J-04	J-05	J-06	J-07	J-08	J-09
seg length (in)[a]	11.319	11.439	14.242	14.043	14.133	13.913	10.498	13.998	13.001	1.62
total length (in)										1.1821E+02
U-232 wt%[b]	0	0.0176	0.0564	0.1686	0.236	0.2702	0.2543	0.1745	0.0584	
+/-[b]	0	0.0005	0.0017	0.0052	0.0073	0.0084	0.0079	0.0054	0.0018	
U-232 g[i]	0.0000E+00	9.7451E-05	3.7210E-03	1.2703E-02	1.9381E-02	1.8384E-02	1.1966E-02	8.0841E-03	9.3828E-04	
+/-[j]	NA	2.7686E-06	1.1216E-04	3.9190E-04	5.9953E-04	5.7154E-04	3.7173E-04	2.5017E-04	2.8921E-05	
Segment Total										7.5275E-02
+/-[n]										1.0266E-03
U-233 wt%[b]	100	98.733	92.715	86.8737	83.8016	86.2766	87.817	91.7185	97.066	
+/-[b]	0	0.0119	0.0091	0.009	0.0093	0.0107	0.0094	0.0067	0.0088	
U-233 g[i]	4.0000E-05	5.4668E-01	6.1169E+00	6.5455E+00	6.8822E+00	5.8700E+00	4.1321E+00	4.2491E+00	1.5595E+00	
+/-[j]	1.0000E-05	1.5313E-04	1.7998E-03	4.8173E-03	2.1044E-03	1.8173E-03	1.0945E-03	9.1633E-04	5.5227E-04	
Segment Total										3.5902E+01
+/-[n]										6.0451E-03
U-234 wt%[b]	0	1.1844	6.2385	10.6871	12.8591	11.0657	9.9651	7.0628	2.7016	
+/-[b]	0	0.0008	0.001	0.0015	0.0017	0.0017	0.0013	0.0008	0.0008	
U-234 g[i]	0.0000E+00	6.5580E-03	4.1159E-01	8.0522E-01	1.0560E+00	7.5288E-01	4.6889E-01	3.2720E-01	4.3405E-02	
+/-[j]	NA	4.7298E-06	1.3186E-04	5.9751E-04	3.3171E-04	2.4288E-04	1.2902E-04	7.6034E-05	1.9647E-05	
Segment Total										3.8718E+00
+/-[n]										7.5250E-04
U-235 wt%[b]	0	0.0375	0.744	1.9413	2.6703	2.1709	1.8062	0.9825	0.1657	
+/-[b]	0	0.0093	0.0075	0.0069	0.0063	0.0069	0.0057	0.0043	0.007	
U-235 g[i]	0.0000E+00	2.0764E-04	4.9086E-02	1.4627E-01	2.1930E-01	1.4770E-01	8.4988E-02	4.5516E-02	2.6622E-03	
+/-[j]	NA	[illegible]	4.9501E-04	5.3069E-04	[illegible]	[illegible]	[illegible]	[illegible]	1.1247E-04	
Segment Total										6.9573E-01
+/-[n]										1.0714E-03
U-236 wt%[b]	0	0.0012	0.0457	0.1746	0.3007	0.2136	0.1553	0.0597	0.0041	
+/-[b]	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
U-236 g[i]	0.0000E+00	6.6444E-06	3.0151E-03	1.3155E-02	2.4695E-02	1.4533E-02	7.3074E-03	2.7657E-03	6.5872E-05	
+/-[j]	NA	5.5370E-07	6.6504E-06	1.2192E-05	1.0815E-05	7.9552E-06	5.0274E-06	4.6666E-06	1.6068E-06	
Segment Total										6.5544E-02
+/-[n]										2.0568E-05

Rod "J" 1200830 (SBI-3 A49)

	J-00	J-01	J-02	J-03	J-04	J-05	J-06	J-07	J-08	J-09
seg length (in)[a]	11.319	11.439	14.242	14.043	14.133	13.913	10.498	13.998	13.001	1.62
total length (in)										1.1821E+02
U-238 wt%[b]	0	0.0263	0.2004	0.1548	0.1324	0.003	0.0021	0.0019	0.0043	
+/-[b]	0	0.0076	0.006	0.0055	0.0051	0.0056	0.0043	0.0024	0.0054	
U-238 g[i]	0.0000E+00	1.4562E-04	1.3222E-02	1.1663E-02	1.0873E-02	2.0411E-04	9.8813E-05	8.8021E-05	6.9086E-05	
+/-[j]	NA	4.2081E-05	3.9587E-04	4.1449E-04	4.1885E-04	3.8101E-04	2.0233E-04	1.1119E-04	8.6759E-05	
Segment Total										3.6364E-02
+/-[n]										8.4363E-04
tot U[c]	0.00015	0.5537	6.59757	7.53452	8.21244	6.80373	4.70536	4.63271	1.60664	
+/-[c]	0.00008	0.00014	0.00183	0.00549	0.00234	0.00193	0.00114	0.00094	0.00055	
Kr-82 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-82 (g)[k]	4.9148E-07	0.0000E+00	1.1788E-04	2.8961E-04	3.9549E-04	2.3680E-04	1.4257E-04	1.4621E-04	2.6967E-05	
+/-[j]	2.4574E-07	NA	7.0761E-05	1.5215E-04	2.0165E-04	1.2127E-04	7.4124E-05	7.5331E-05	1.4921E-05	
Segment Total										1.3560E-03
+/-[n]										3.0808E-04
Kr-83 (mol%)[d]	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	14.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-83 (g)[k]	3.6565E-05	0.0000E+00	8.7702E-03	2.1546E-02	2.9423E-02	1.7617E-02	1.0607E-02	1.0878E-02	2.0063E-03	
+/-[j]	2.4874E-07	NA	2.9136E-03	3.4768E-03	2.9443E-03	1.9539E-03	1.5131E-03	1.3550E-03	4.7560E-04	
Segment Total										1.0088E-01
+/-[n]										6.1169E-03
Kr-84 (mol%)[d]	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	30.6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-84 (g)[k]	7.7031E-05	0.0000E+00	1.8476E-02	4.5391E-02	6.1985E-02	3.7114E-02	2.2345E-02	2.2915E-02	4.2266E-03	
+/-[j]	2.5173E-07	NA	6.1371E-03	7.3195E-03	6.1916E-03	4.1103E-03	3.1849E-03	2.8512E-03	1.0016E-03	
Segment Total										2.1253E-01
+/-[n]										1.2874E-02

Rod "J" 1200830 (SBI-3 A49)

	J-00	J-01	J-02	J-03	J-04	J-05	J-06	J-07	J-08	J-09
seg length (in)[a]	11.319	11.439	14.242	14.043	14.133	13.913	10.498	13.998	13.001	1.62
total length (in)										1.1821E+02
Kr-85 (mol%)[d]	6	6	6	6	6	6	6	6	6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	1.5284E-05	0.0000E+00	3.6659E-03	9.0064E-03	1.2299E-02	7.3641E-03	4.4337E-03	4.5468E-03	8.3863E-04	
+/-[j]	2.5474E-07	NA	1.2192E-03	1.4598E-03	1.2449E-03	8.2438E-04	6.3608E-04	5.7058E-04	1.9921E-04	
Segment Total										4.2170E-02
+/-[n]										2.5722E-03
Kr-86 (mol%)[d]	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	
+/-[d]	0.2	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	
Kr-86 (g)[k]	1.2526E-04	0.0000E+00	3.0043E-02	7.3809E-02	1.0079E-01	6.0350E-02	3.6335E-02	3.7262E-02	6.8728E-03	
+/-[j]	5.1546E-07	NA	3.1657E-02	7.4762E-02	1.0129E-01	6.0719E-02	3.6702E-02	3.7549E-02	7.0631E-03	
Segment Total										3.4559E-01
+/-[n]										1.5279E-01
Rod Total										7.0253E-01
+/-[n]										1.5348E-01
shear gas (g)[e]	0	0	0.001	0.0029	0.0041	0.0037	0.0024	0.0014	0.0003	
+/-[e]	0	0.0003	0.0003	0.0006	0.0008	0.0007	0.0005	0.0003	0.0003	
moles Kr (diss+pl)[d]	0.000003	0	0.000718	0.001763	0.002407	0.00144	0.000866	0.00089	0.000164	
+/-[d]	0	0	0.000239	0.000285	0.000241	0.00016	0.000124	0.000111	0.000039	
Kr+Xe diss&pl (g)[d]	0.0016	0.0099	0.4625	1.0696	1.4004	0.9815	0.4887	0.5088	0.081	
+/-[d]	0	0.0099	0.0829	0.1727	0.115	0.1439	0.0509	0.0314	0.011	
moles kr (tot)[o]	3.0000E-06	0.0000E+00	7.1955E-04	1.7678E-03	2.4140E-03	1.4454E-03	8.7025E-04	8.9245E-04	1.6461E-04	
+/-[p]	0	0.0000E+00	2.3900E-04	2.8500E-04	2.4101E-04	1.6001E-04	1.2401E-04	1.1100E-04	3.9005E-05	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	0	0	
Xe-128 (g)[k]	1.2790E-06	9.4649E-06	3.8326E-04	8.7851E-04	1.1423E-03	8.2141E-04	3.9742E-04	4.1375E-04	6.4189E-05	
+/-[j]	0.0000E+00	9.4649E-06	7.6487E-05	1.4146E-04	1.0540E-04	1.3635E-04	4.7455E-05	2.8524E-05	9.9794E-06	
SegmentTotal										4.1116E-03
+/-[n]										2.4252E-04

Rod "J" 1200830 (SBI-3 A49)

	J-00	J-01	J-02	J-03	J-04	J-05	J-06	J-07	J-08	J-09
seg length (in)[a]	11.319	11.439	14.242	14.043	14.133	13.913	10.498	13.998	13.001	1.62
total length (in)										1.1821E+02
Xe-130 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0	0	0	0	0	0	0	0	0	
Xe-130 (g)[k]	2.5981E-06	1.9226E-05	7.7850E-04	1.7845E-03	2.3204E-03	1.6685E-03	8.0727E-04	8.4044E-04	1.3038E-04	
+/-[J]	0.0000E+00	1.9226E-05	1.5537E-04	2.8735E-04	2.1409E-04	2.7696E-04	9.6394E-05	5.7939E-05	2.0271E-05	
SegmentTotal										8.3518E-03
+/-[n]										4.9262E-04
Xe-131 (mol%)[d]	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	10.6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	1.3876E-04	1.0268E-03	4.1579E-02	9.5308E-02	1.2393E-01	8.9113E-02	4.3115E-02	4.4887E-02	6.9637E-03	
+/-[J]	1.3091E-06	1.0269E-03	8.3072E-03	1.5373E-02	1.1494E-02	1.4816E-02	5.1643E-03	3.1233E-03	1.0846E-03	
SegmentTotal										4.4606E-01
+/-[n]										2.6375E-02
Xe-132 (mol%)[d]	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	22.3	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	2.9415E-04	2.1767E-03	8.8140E-02	2.0204E-01	2.6270E-01	1.8890E-01	9.1397E-02	9.5153E-02	1.4762E-02	
+/-[J]	1.3190E-06	2.1767E-03	1.7595E-02	3.2546E-02	2.4267E-02	3.1368E-02	1.0921E-02	6.5736E-03	2.2960E-03	
SegmentTotal										9.4557E-01
+/-[n]										5.5804E-02
Xe-134 (mol%)[d]	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	24.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-134 (g)[k]	3.3075E-04	2.4475E-03	9.9107E-02	2.2718E-01	2.9539E-01	2.1241E-01	1.0277E-01	1.0699E-01	1.6599E-02	
+/-[J]	1.3391E-06	2.4475E-03	1.9783E-02	3.6593E-02	2.7280E-02	3.5269E-02	1.2278E-02	7.3887E-03	2.5815E-03	
SegmentTotal										1.0632E+00
+/-[n]										6.2742E-02

Rod "J" 1200830 (SBI-3 A49)

	J-00	J-01	J-02	J-03	J-04	J-05	J-06	J-07	J-08	J-09
seg length (in)[a]	11.319	11.439	14.242	14.043	14.133	13.913	10.498	13.998	13.001	1.62
total length (in)										1.1821E+02
Xe-136 (mol%)[d]	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	42.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-136 (g)[k]	5.7217E-04	4.2341E-03	1.7145E-01	3.9300E-01	5.1101E-01	3.6745E-01	1.7778E-01	1.8509E-01	2.8714E-02	
+/-[j]	1.3591E-06	4.2341E-03	3.4218E-02	6.3290E-02	4.7164E-02	6.1001E-02	2.1233E-02	1.2767E-02	4.4648E-03	
SegmentTotal										1.8393E+00
+/-[n]										1.0851E-01
Rod total										4.3066E+00
+/-[n]										1.3971E-01
shear gas (g)[e]	0	0	0.001	0.0029	0.0041	0.0037	0.0024	0.0014	0.0003	
+/-[e]	0	0.0003	0.0003	0.0006	0.0008	0.0007	0.0005	0.0003	0.0003	
moles Xe (diss+pl)[d]	0.00001	0.000074	0.00299	0.00685	0.008905	0.006398	0.003092	0.003226	0.0005	
+/-[d]	0	0.000074	0.000598	0.001106	0.000824	0.001066	0.000371	0.000223	0.000078	
Kr+Xe diss&pl (g)[d]	0.0016	0.0099	0.4625	1.0696	1.4004	0.9815	0.4887	0.5088	0.081	
+/-[d]	0	0.0099	0.0829	0.1727	0.115	0.1439	0.0509	0.0314	0.011	
moles Xe (tot)[o]	1.0000E-05	7.4000E-05	2.9965E-03	6.8686E-03	8.9311E-03	6.4221E-03	3.1072E-03	3.2349E-03	5.0185E-04	
+/-[p]	0.0000E+00	7.4000E-05	5.9801E-04	1.1060E-03	8.2402E-04	1.0660E-03	3.7102E-04	2.2301E-04	7.8023E-05	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project										
Cs-137 (atoms)[f]	NA	7.9560E+18	4.7870E+20	1.0570E+21	1.4330E+21	9.5010E+20	5.7340E+20	3.9240E+20	5.2010E+19	
+/-[f]	NA	3.0260E+16	1.7590E+18	3.3690E+18	5.1170E+18	3.4210E+18	2.0630E+18	1.4010E+18	1.8710E+17	
Cs-137 (g)[m]	NA	1.8085E-03	1.0882E-01	2.4027E-01	3.2574E-01	2.1597E-01	1.3034E-01	8.9198E-02	1.1823E-02	
+/-[m]	NA	6.8785E-06	3.9985E-04	7.6582E-04	1.1632E-03	7.7764E-04	4.6895E-04	3.1847E-04	4.2530E-05	
Total										1.1240E+00
+/-[n]										1.7399E-03
Ce-144 (atoms)[g]	NA	9.4980E+17	3.2740E+19	5.9000E+19	7.5920E+19	6.4530E+19	3.7170E+19	2.2670E+19	2.6570E+18	
+/-[g]	NA	6.8400E+15	2.3930E+17	3.8520E+17	5.4560E+17	4.6480E+17	2.6760E+17	1.6300E+17	1.9130E+16	
Ce-144 (g)[m]	NA	2.2695E-04	7.8231E-03	1.4098E-02	1.8141E-02	1.5419E-02	8.8817E-03	5.4169E-03	6.3488E-04	
+/-[m]	NA	1.6344E-06	5.7180E-05	9.2043E-05	1.3037E-04	1.1106E-04	6.3942E-05	3.8948E-05	4.5711E-06	
Total										7.0642E-02
+/-[n]										2.1611E-04

Rod "J" 1200830 (SBI-3 A49)

	J-00	J-01	J-02	J-03	J-04	J-05	J-06	J-07	J-08	J-09
seg length (in)[a]	11.319	11.439	14.242	14.043	14.133	13.913	10.498	13.998	13.001	1.62
total length (in)										1.1821E+02
Zr-95 (atoms)[h]	NA	9.4020E+15	3.0250E+17	4.6690E+17	5.8520E+17	4.9840E+17	2.2260E+17	8.8260E+16	6.3910E+15	
+/-[h]	NA	1.9670E+14	1.0230E+16	2.0470E+16	2.8950E+16	1.4380E+16	1.0920E+16	6.7150E+15	4.7640E+14	
Zr-95 (g)[m]	NA	1.4816E-06	4.7668E-05	7.3575E-05	9.2216E-05	7.8538E-05	3.5078E-05	1.3908E-05	1.0071E-06	
+/-[m]	NA	3.0996E-08	1.6121E-06	3.2257E-06	4.5620E-06	2.2660E-06	1.7208E-06	1.0582E-06	7.5072E-08	
Total										3.4347E-04
+/-[n]										6.5603E-06

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod J, 1200830, page 3
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod J, 1200830, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod J, 1200830, page 7
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod J, 1200830, page 10
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod J, 1200830, page 11
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod J, 1200830, page 12
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod J, 1200830, page 13
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod J, 1200830, page 14
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "K" 1302864 (SBI-3 D24)

	K-00	K-01	K-02	K-03	K-04	K-05	K-06	K-07	K-08	K-09
seg length (in)[a]	11.38	8.308	14.235	14.034	14.034	14.019	14.135	10.412	14.958	2.64
total length (in)										1.1816E+02
U-232 wt%[b]	0	0.0128	0.0291	0.1049	0.1592	0.1676	0.133	0.1374	0.0444	
+/-[b]	0	0.0004	0.0009	0.0032	0.0049	0.0052	0.0041	0.0043	0.0014	
U-232 g[i]	0.0000E+00	5.8481E-05	2.7294E-03	9.9356E-03	1.5410E-02	1.6117E-02	1.2302E-02	3.5445E-03	5.8093E-04	
+/-[j]	NA	1.8276E-06	8.4417E-05	3.0310E-04	4.7433E-04	5.0006E-04	3.7925E-04	1.1093E-04	1.8318E-05	
Segment Total										6.0678E-02
+/-[n]										8.5470E-04
U-233 wt%[b]	100	98.3699	94.4057	89.9048	87.363	86.6543	87.5838	94.6213	97.8966	
+/-[b]	0	0.0138	0.0055	0.0064	0.0063	0.007	0.0064	0.0105	0.0126	
U-233 g[i]	4.0000E-05	4.4943E-01	8.8547E+00	8.5154E+00	8.4566E+00	8.3328E+00	8.1012E+00	2.4410E+00	1.2809E+00	
+/-[j]	1.0000E-05	1.4258E-04	2.3790E-03	2.3801E-03	2.1584E-03	2.2934E-03	2.2091E-03	7.7731E-04	3.8908E-04	
Segment Total										4.6432E+01
+/-[n]										5.1864E-03
U-234 wt%[b]	0	1.4383	4.7304	8.3343	10.2387	10.7721	10.1038	4.7319	1.9496	
+/-[b]	0	0.0007	0.0007	0.0009	0.001	0.0012	0.0011	0.0008	0.0007	
U-234 g[i]	0.0000E+00	6.5713E-03	4.4368E-01	7.8939E-01	9.9109E-01	1.0359E+00	9.3456E-01	1.2207E-01	2.5508E-02	
+/-[j]	NA	3.7046E-06	1.3361E-04	2.2976E-04	2.6125E-04	2.9596E-04	2.6577E-04	4.1875E-05	1.1539E-05	
Segment Total										4.3487E+00
+/-[n]										5.4682E-04
U-235 wt%[b]	0	0.0848	0.5397	1.3262	1.8664	2.0106	1.8017	0.4871	0.0975	
+/-[b]	0	0.01	0.0041	0.0045	0.0037	0.0043	0.0042	0.0073	0.0092	
U-235 g[i]	0.0000E+00	3.8743E-04	5.0621E-02	1.2561E-01	1.8066E-01	1.9334E-01	1.6665E-01	1.2566E-02	1.2757E-03	
+/-[j]	NA	4.5688E-05	3.8478E-04	4.2757E-04	3.6087E-04	4.1661E-04	3.9094E-04	1.8836E-04	1.2037E-04	
Segment Total										7.3112E-01
+/-[n]										9.1628E-04
U-236 wt%[b]	0	0.0131	0.0601	0.1188	0.1789	0.1986	0.1706	0.0182	0.0016	
+/-[b]	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
U-236 g[i]	0.0000E+00	5.9851E-05	5.6370E-03	1.1252E-02	1.7317E-02	1.9098E-02	1.5780E-02	4.6951E-04	2.0934E-05	
+/-[j]	NA	4.5720E-07	9.4952E-06	9.9478E-06	1.0568E-05	1.0850E-05	1.0136E-05	2.5835E-06	1.3084E-06	
Segment Total										6.9634E-02
+/-[n]										2.3018E-05

Rod "K" 1302864 (SBI-3 D24)

	K-00	K-01	K-02	K-03	K-04	K-05	K-06	K-07	K-08	K-09
seg length (in)[a]	11.38	8.308	14.235	14.034	14.034	14.019	14.135	10.412	14.958	2.64
total length (in)										1.1816E+02
U-238 wt%[b]	0	0.0811	0.2349	0.211	0.1938	0.1967	0.2071	0.0041	0.0104	
+/-[b]	0	0.0098	0.0039	0.0044	0.0036	0.0042	0.0041	0.0072	0.0089	
U-238 g[i]	0.0000E+00	3.7053E-04	2.2032E-02	1.9985E-02	1.8759E-02	1.8915E-02	1.9156E-02	1.0577E-04	1.3607E-04	
+/-[j]	NA	4.4774E-05	3.6584E-04	4.1678E-04	3.4850E-04	4.0391E-04	3.7927E-04	1.8574E-04	1.1645E-04	
Segment Total										9.9460E-02
+/-[n]										8.8660E-04
tot U[c]	0.00236	0.45688	9.37938	9.47154	9.67982	9.61619	9.24963	2.57973	1.30839	
+/-[c]	0.00002	0.00013	0.00246	0.00256	0.00237	0.00253	0.00243	0.00077	0.00036	
Kr-82 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-82 (g)[k]	4.9148E-07	1.8878E-07	1.2123E-04	2.6573E-04	3.3803E-04	3.9079E-04	3.8142E-04	4.5741E-05	1.3761E-05	
+/-[j]	1.5171E-05	NA	6.2459E-05	1.3518E-04	1.7192E-04	1.9890E-04	1.9412E-04	2.4642E-05	7.4230E-06	
Segment Total										1.5574E-03
+/-[n]										3.6037E-04
Kr-83 (mol%)[d]	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	15.6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-83 (g)[k]	3.8804E-05	1.4904E-05	9.5711E-03	2.0980E-02	2.6688E-02	3.0854E-02	3.0114E-02	3.6114E-03	1.0865E-03	
+/-[j]	1.1976E-03	NA	1.1916E-03	1.9707E-03	2.4894E-03	2.9428E-03	2.8651E-03	7.2475E-04	2.2000E-04	
Segment Total										1.2296E-01
+/-[n]										5.5116E-03
Kr-84 (mol%)[d]	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	29.8	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-84 (g)[k]	7.5017E-05	2.8814E-05	1.8503E-02	4.0560E-02	5.1595E-02	5.9647E-02	5.8218E-02	6.9817E-03	2.1005E-03	
+/-[j]	2.3153E-03	NA	2.3014E-03	3.8033E-03	4.8043E-03	5.6798E-03	5.5297E-03	1.4006E-03	4.2515E-04	
Segment Total										2.3771E-01
+/-[n]										1.0639E-02

Rod "K" 1302864 (SBI-3 D24)

	K-00	K-01	K-02	K-03	K-04	K-05	K-06	K-07	K-08	K-09
seg length (in)[a]	11.38	8.308	14.235	14.034	14.034	14.019	14.135	10.412	14.958	2.64
total length (in)										1.1816E+02
Kr-85 (mol%)[d]	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	1.4775E-05	5.6749E-06	3.6442E-03	7.9883E-03	1.0162E-02	1.1748E-02	1.1466E-02	1.3751E-03	4.1369E-04	
+/-[j]	4.5601E-04	NA	4.5744E-04	7.6116E-04	9.6169E-04	1.1362E-03	1.1062E-03	2.7683E-04	8.4027E-05	
Segment Total										4.6817E-02
+/-[n]										2.1260E-03
Kr-86 (mol%)[d]	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	48.6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-86 (g)[k]	1.2526E-04	4.8111E-05	3.0895E-02	6.7723E-02	8.6150E-02	9.9595E-02	9.7208E-02	1.1658E-02	3.5072E-03	
+/-[j]	3.8660E-03	NA	3.8418E-03	6.3480E-03	8.0186E-03	9.4801E-03	9.2296E-03	2.3384E-03	7.0983E-04	
Segment Total										3.9691E-01
+/-[n]										1.7758E-02
Rod Total										8.0595E-01
+/-[n]										2.1530E-02
shear gas (g)[e]	0	0.0006	0.0005	0.0017	0.0024	0.002	0.0018	0.0001	0	
+/-[e]	0	0.0003	0.0003	0.0003	0.0005	0.0004	0.0004	0.0003	0.0003	
moles Kr (diss+pl)[d]	0.000003	0	0.000739	0.001619	0.002059	0.002382	0.002325	0.000279	0.000084	
+/-[d]	0	0	0.000092	0.000152	0.000192	0.000227	0.000221	0.000056	0.000017	
Kr+Xe diss&pl (g)[d]	0.0018	0	0.3848	0.9115	1.1391	1.42	1.3119	0.136	0.0372	
+/-[d]	0.0001	0	[illegible]	0.0558	[illegible]	[illegible]	[illegible]	0.0157	0.007	
moles kr (tot)[o]	3.0000E-06	1.1523E-06	7.3996E-04	1.6220E-03	2.0633E-03	2.3854E-03	2.3282E-03	2.7921E-04	8.4000E-05	
+/-[p]	9.2593E-05	6.0142E-07	9.2002E-05	1.5200E-04	1.9200E-04	2.2700E-04	2.2100E-04	5.6003E-05	1.7000E-05	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	0	0	
Xe-128 (g)[k]	1.4069E-06	4.7864E-07	3.0737E-04	7.3900E-04	9.2079E-04	1.1621E-03	1.0636E-03	1.0713E-04	2.8650E-05	
+/-[j]	8.3276E-05	2.4694E-07	2.9547E-05	5.1802E-05	1.2253E-04	7.2522E-05	1.4159E-04	1.4327E-05	7.1626E-06	
SegmentTotal										4.3305E-03
+/-[n]										2.2599E-04

Rod "K" 1302864 (SBI-3 D24)

	K-00	K-01	K-02	K-03	K-04	K-05	K-06	K-07	K-08	K-09
seg length (in)[a]	11.38	8.308	14.235	14.034	14.034	14.019	14.135	10.412	14.958	2.64
total length (in)										1.1816E+02
Xe-130 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0	0	0	0	0	0	0	0	0	
Xe-130 (g)[k]	2.8579E-06	9.7225E-07	6.2435E-04	1.5011E-03	1.8704E-03	2.3605E-03	2.1604E-03	2.1762E-04	5.8197E-05	
+/-[j]	1.6916E-04	5.0161E-07	6.0017E-05	1.0522E-04	2.4890E-04	1.4731E-04	2.8761E-04	2.9102E-05	1.4549E-05	
SegmentTotal										8.7964E-03
+/-[n]										4.5904E-04
Xe-131 (mol%)[d]	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	1.6991E-04	5.7805E-05	3.7120E-02	8.9248E-02	1.1120E-01	1.4035E-01	1.2845E-01	1.2938E-02	3.4601E-03	
+/-[j]	1.0057E-02	2.9827E-05	3.5822E-03	6.3016E-03	1.4828E-02	8.8388E-03	1.7134E-02	1.7337E-03	8.6552E-04	
SegmentTotal										5.2299E-01
+/-[n]										2.7368E-02
Xe-132 (mol%)[d]	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	22.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	3.2936E-04	1.1205E-04	7.1955E-02	1.7300E-01	2.1556E-01	2.7205E-01	2.4898E-01	2.5080E-02	6.7071E-03	
+/-[j]	1.9495E-02	5.7812E-05	6.9242E-03	1.2151E-02	2.8701E-02	1.7020E-02	3.3164E-02	3.3558E-03	1.6770E-03	
SegmentTotal										1.0138E+00
+/-[n]										5.2943E-02
Xe-134 (mol%)[d]	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	25.8	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-134 (g)[k]	3.8002E-04	1.2928E-04	8.3022E-02	1.9961E-01	2.4871E-01	3.1389E-01	2.8728E-01	2.8938E-02	7.7387E-03	
+/-[j]	2.2493E-02	6.6703E-05	7.9873E-03	1.4013E-02	3.3111E-02	1.9626E-02	3.8261E-02	3.8715E-03	1.9349E-03	
SegmentTotal										1.1697E+00
+/-[n]										6.1076E-02

Rod "K" 1302864 (SBI-3 D24)

	K-00	K-01	K-02	K-03	K-04	K-05	K-06	K-07	K-08	K-09
seg length (in)[a]	11.38	8.308	14.235	14.034	14.034	14.019	14.135	10.412	14.958	2.64
total length (in)										1.1816E+02
Xe-136 (mol%)[d]	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	39.4	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-136 (g)[k]	5.8902E-04	2.0039E-04	1.2868E-01	3.0938E-01	3.8550E-01	4.8652E-01	4.4527E-01	4.4852E-02	1.1995E-02	
+/-[j]	3.4864E-02	1.0339E-04	1.2374E-02	2.1701E-02	5.1308E-02	3.0387E-02	5.9288E-02	5.9992E-03	2.9988E-03	
SegmentTotal										1.8130E+00
+/-[n]										9.4633E-02
Rod total										4.5326E+00
+/-[n]										1.2743E-01
shear gas (g)[e]	0	0.0006	0.0005	0.0017	0.0024	0.002	0.0018	0.0001	0	
+/-[e]	0	0.0003	0.0003	0.0003	0.0005	0.0004	0.0004	0.0003	0.0003	
moles Xe (diss+pl)[d]	0.000011	0	0.0024	0.005767	0.007184	0.009073	0.008304	0.000837	0.000224	
+/-[d]	0.000001	0	0.000231	0.000405	0.000958	0.000567	0.001107	0.000112	0.000056	
Kr+Xe diss&pl (g)[d]	0.0018	0	0.3848	0.9115	1.1391	1.42	1.3119	0.136	0.0372	
+/-[d]	0.0001	0	0.032	0.0558	0.1296	0.0786	0.1498	0.0157	0.0076	
moles Xe (tot)[o]	1.1000E-05	3.7422E-06	2.4031E-03	5.7778E-03	7.1991E-03	9.0858E-03	8.3154E-03	8.3762E-04	2.2400E-04	
+/-[p]	6.5108E-04	1.9307E-06	2.3101E-04	4.0501E-04	9.5801E-04	5.6701E-04	1.1070E-03	1.1202E-04	5.6000E-05	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project										
Cs-137 (atoms)[l]	NA	6.2820E+18	4.2230E+20	9.1210E+20	1.2080E+21	1.2810E+21	1.1440E+21	1.3930E+20	2.9880E+19	
+/-[l]	NA	2.2020E+16	1.4210E+18	2.9660E+18	3.9320E+18	4.1660E+18	3.7150E+18	4.7270E+17	1.0050E+17	
Cs-137 (g)[m]	NA	1.4280E-03	9.5995E-02	2.0733E-01	2.7460E-01	2.9119E-01	2.6005E-01	3.1665E-02	6.7921E-03	
+/-[m]	NA	5.0055E-06	3.2301E-04	6.7421E-04	8.9380E-04	9.4699E-04	8.4447E-04	1.0745E-04	2.2845E-05	
Total										1.1690E+00
+/-[n]										1.7262E-03
Ce-144 (atoms)[g]	NA	6.7410E+17	2.9070E+19	4.9780E+19	6.1220E+19	6.4670E+19	5.0810E+19	8.0980E+18	1.5090E+18	
+/-[g]	NA	3.8260E+15	1.6890E+17	2.8160E+17	3.4650E+17	3.6580E+17	2.8730E+17	5.0540E+16	9.3910E+15	
Ce-144 (g)[m]	NA	1.6107E-04	6.9462E-03	1.1895E-02	1.4628E-02	1.5453E-02	1.2141E-02	1.9350E-03	3.6057E-04	
+/-[m]	NA	9.1421E-07	4.0358E-05	6.7288E-05	8.2795E-05	8.7407E-05	6.8650E-05	1.2076E-05	2.2440E-06	
Total										6.3520E-02
+/-[n]										1.5974E-04

Rod "K" 1302864 (SBI-3 D24)

	K-00	K-01	K-02	K-03	K-04	K-05	K-06	K-07	K-08	K-09
seg length (in)[a]	11.38	8.308	14.235	14.034	14.034	14.019	14.135	10.412	14.958	2.64
total length (in)										1.1816E+02
Zr-95 (atoms)[h]	NA	6.7480E+15	2.5440E+17	4.1470E+17	4.2840E+17	4.4320E+17	2.5090E+17	2.9420E+16	3.6590E+15	
+/-[h]	NA	1.4920E+14	7.0750E+15	1.6760E+16	2.6570E+16	2.3570E+16	2.0430E+16	3.4420E+15	4.7820E+14	
Zr-95 (g)[m]	NA	1.0634E-06	4.0089E-05	6.5349E-05	6.7508E-05	6.9840E-05	3.9537E-05	4.6360E-06	5.7659E-07	
+/-[m]	NA	2.3511E-08	1.1149E-06	2.6411E-06	4.1869E-06	3.7142E-06	3.2194E-06	5.4239E-07	7.5355E-08	
Total										2.8860E-04
+/-[n]										7.0858E-06

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod K, 1302864, page 3
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod K, 1302864, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod K, 1302864, page 7
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod K, 1302864, page 10
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod K, 1302864, page 11
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod K, 1302864, page 12
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod K, 1302864, page 13
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod K, 1302864, page 14
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "L" 1400544 (SBI-3 C3)

	L-00	L-01	L-02	L-03	L-04	L-05	L-06	L-07	L-08	L-09
seg length (in)[a]	11.176	11.007	14.373	14.172	14.17	14.25	13.927	10.499	12.941	1.638
total length (in)										1.1815E+02
U-232 wt%[b]	0	0.0143	0.0336	0.1192	0.1774	0.1849	0.2232	0.133	0.0456	
+/-[b]	0	0.0004	0.001	0.0037	0.0055	0.0057	0.0069	0.0041	0.0014	
U-232 g[j]	0.0000E+00	5.3335E-05	2.7665E-03	1.0328E-02	1.6010E-02	1.6521E-02	1.1600E-02	3.5743E-03	5.7880E-04	
+/-[j]	NA	1.4920E-06	8.2341E-05	3.2060E-04	4.9638E-04	5.0932E-04	3.5860E-04	1.1019E-04	1.7771E-05	
Segment Total										6.1431E-02
+/-[n]										8.6972E-04
U-233 wt%[b]	100	99.1263	94.4905	89.8566	87.2258	86.2043	91.2627	94.2375	97.6803	
+/-[b]	0	0.0165	0.0072	0.0069	0.0078	0.0078	0.0083	0.0074	0.0085	
U-233 g[j]	4.0000E-05	3.6971E-01	7.7800E+00	7.7855E+00	7.8718E+00	7.7023E+00	4.7429E+00	2.5325E+00	1.2399E+00	
+/-[j]	1.0000E-05	1.4280E-04	2.3989E-03	2.3420E-03	2.4748E-03	2.3966E-03	1.2538E-03	7.4330E-04	3.3992E-04	
Segment Total										4.0025E+01
+/-[n]										5.0367E-03
U-234 wt%[b]	0	0.8088	4.7282	8.4153	10.371	11.1056	7.3494	5.0538	2.1524	
+/-[b]	0	0.001	0.001	0.0012	0.0014	0.0014	0.0011	0.001	0.001	
U-234 g[j]	0.0000E+00	3.0166E-03	3.8930E-01	7.2913E-01	9.3595E-01	9.9228E-01	3.8195E-01	1.3582E-01	2.7320E-02	
+/-[j]	NA	3.8751E-06	1.4251E-04	2.3618E-04	3.0909E-04	3.2080E-04	1.1071E-04	4.6877E-05	1.4545E-05	
Segment Total										3.5948E+00
+/-[n]										5.3779E-04
U-235 wt%[b]	0	0.0168	0.4773	1.3112	1.8817	2.1282	1.0983	0.5512	0.1127	
+/-[b]	0	0.0118	0.0055	0.0048	0.005	0.005	0.0043	0.0048	0.0062	
U-235 g[j]	0.0000E+00	6.2659E-05	3.9299E-02	1.1361E-01	1.6982E-01	1.9015E-01	5.7078E-02	1.4813E-02	1.4305E-03	
+/-[j]	NA	4.4010E-05	4.5300E-04	4.1720E-04	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
Segment T[illegible]										5.8626E-01
+/-[n]										9.2909E-04
U-236 wt%[b]	0	0.0002	0.025	0.0877	0.1539	0.1868	0.0646	0.0218	0.0021	
+/-[b]	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
U-236 g[j]	0.0000E+00	7.4594E-07	2.0584E-03	7.5987E-03	1.3889E-02	1.6690E-02	3.3572E-03	5.8586E-04	2.6655E-05	
+/-[j]	NA	3.7297E-07	8.2566E-06	8.9418E-06	9.9483E-06	1.0224E-05	5.2634E-06	2.6925E-06	1.2693E-06	
Segment Total										4.4207E-02
+/-[n]										1.9706E-05

Rod "L" 1400544 (SBI-3 C3)

	L-00	L-01	L-02	L-03	L-04	L-05	L-06	L-07	L-08	L-09
seg length (in)[a]	11.176	11.007	14.373	14.172	14.17	14.25	13.927	10.499	12.941	1.638
total length (in)										1.1815E+02
U-238 wt%[b]	0	0.0336	0.2453	0.2101	0.1904	0.1902	0.0019	0.0027	0.0069	
+/-[b]	0	0.0116	0.0051	0.0044	0.0047	0.0047	0.0038	0.0044	0.0059	
U-238 g[i]	0.0000E+00	1.2532E-04	2.0197E-02	1.8204E-02	1.7183E-02	1.6994E-02	9.8743E-05	7.2560E-05	8.7582E-05	
+/-[j]	NA	4.3265E-05	4.1996E-04	3.8127E-04	4.2419E-04	4.1997E-04	1.9749E-04	1.1825E-04	7.4889E-05	
Segment Total										7.2962E-02
+/-[n]										8.5937E-04
tot U[c]	0.00036	0.37297	8.23365	8.66438	9.02466	8.93494	5.19698	2.68741	1.2693	
+/-[c]	0.00002	0.00013	0.00246	0.00252	0.00272	0.00266	0.00129	0.00076	0.00033	
Kr-82 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-82 (g)[k]	3.2765E-07	0.0000E+00	5.7477E-05	1.3365E-04	1.7176E-04	1.5191E-04	7.0627E-05	2.4863E-05	6.3549E-06	
+/-[j]	6.7776E-06	NA	5.7991E-05	1.3451E-04	1.7246E-04	1.5344E-04	7.1252E-05	2.5360E-05	6.7563E-06	
Segment Total										6.1697E-04
+/-[n]										2.8382E-04
Kr-83 (mol%)[d]	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	15.2	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-83 (g)[k]	5.0412E-05	0.0000E+00	8.8433E-03	2.0563E-02	2.6426E-02	2.3372E-02	1.0866E-02	3.8253E-03	9.7774E-04	
+/-[j]	1.0416E-03	NA	1.1904E-03	2.3597E-03	2.4197E-03	3.3414E-03	1.4564E-03	7.7046E-04	3.5320E-04	
Segment Total										9.4924E-02
+/-[n]										5.2848E-03
Kr-84 (mol%)[d]	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	30.1	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-84 (g)[k]	1.0103E-04	0.0000E+00	1.7723E-02	4.1209E-02	5.2961E-02	4.6840E-02	2.1777E-02	7.6663E-03	1.9595E-03	
+/-[j]	2.0874E-03	NA	2.3771E-03	4.7059E-03	4.8118E-03	6.6753E-03	2.9082E-03	1.5416E-03	7.0750E-04	
Segment Total										1.9024E-01
+/-[n]										1.0545E-02

Rod "L" 1400544 (SBI-3 C3)

	L-00	L-01	L-02	L-03	L-04	L-05	L-06	L-07	L-08	L-09
seg length (in)[a]	11.176	11.007	14.373	14.172	14.17	14.25	13.927	10.499	12.941	1.638
total length (in)										1.1815E+02
Kr-85 (mol%)[d]	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-85 (g)[k]	1.8341E-05	0.0000E+00	3.2174E-03	7.4812E-03	9.6146E-03	8.5034E-03	3.9535E-03	1.3918E-03	3.5573E-04	
+/-[j]	3.7895E-04	NA	4.4719E-04	8.9675E-04	9.4118E-04	1.2508E-03	5.4726E-04	2.8442E-04	1.2909E-04	
Segment Total										3.4536E-02
+/-[n]										1.9988E-03
Kr-86 (mol%)[d]	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	49.2	
+/-[d]	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	
Kr-86 (g)[k]	1.6907E-04	0.0000E+00	2.9659E-02	6.8963E-02	8.8629E-02	7.8386E-02	3.6444E-02	1.2830E-02	3.2792E-03	
+/-[j]	3.4932E-03	NA	3.9774E-03	7.8731E-03	8.0492E-03	1.1169E-02	4.8660E-03	2.5796E-03	1.1840E-03	
Segment Total										3.1836E-01
+/-[n]										1.7643E-02
Rod Total										6.3867E-01
+/-[n]										2.1319E-02
shear gas (g)[e]	0	0	0.0004	0.0015	0.0022	0.0025	0.0007	0.0003	0.0003	
+/-[e]	0	0.0003	0.0003	0.0003	0.0004	0.0005	0.0003	0.0003	0.0003	
moles Kr (diss+pl)[d]	0.000004	0	0.000701	0.001629	0.002093	0.00185	0.000861	0.000303	0.000077	
+/-[d]	0	0	0.000094	0.000186	0.00019	0.000264	0.000115	0.000061	0.000028	
Kr+Xe diss&pl (g)[d]	0.0022	0	0.4112	0.9508	1.1996	1.0265	0.4973	0.1722	0.0398	
+/-[d]	[illegible]	0	0.0324	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
moles kr (tot)[i]	4.0000E-06	0	7.0168E-04	1.6316E-03	2.0968E-03	1.8545E-03	8.6221E-04	3.0353E-04	7.7580E-05	
+/-[p]	8.2645E-05	0	9.4001E-05	1.8600E-04	1.9000E-04	2.6400E-04	1.1500E-04	6.1002E-05	2.8007E-05	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	0	0	
Xe-128 (g)[k]	1.6627E-06	0.0000E+00	3.3531E-04	7.7517E-04	9.7526E-04	8.3019E-04	4.0462E-04	1.3979E-04	3.1959E-05	
+/-[j]	6.7530E-05	NA	2.9930E-05	5.9476E-05	1.2164E-04	8.4546E-05	4.4127E-05	1.5478E-05	5.6331E-06	
SegmentTotal										3.4939E-03
+/-[n]										1.8209E-04

Rod "L" 1400544 (SBI-3 C3)

	L-00	L-01	L-02	L-03	L-04	L-05	L-06	L-07	L-08	L-09
seg length (in)[a]	11.176	11.007	14.373	14.172	14.17	14.25	13.927	10.499	12.941	1.638
total length (in)										1.1815E+02
Xe-130 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	0	0	
Xe-130 (g)[k]	1.6887E-06	0.0000E+00	3.4055E-04	7.8729E-04	9.9051E-04	8.4317E-04	4.1094E-04	1.4197E-04	3.2459E-05	
+/-[j]	6.8586E-05	NA	3.0398E-05	6.0406E-05	1.2354E-04	8.5868E-05	4.4817E-05	1.5720E-05	5.7212E-06	
SegmentTotal										3.5466E-03
+/-[n]										1.8493E-04
Xe-131 (mol%)[d]	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	11.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	1.8890E-04	0.0000E+00	3.8092E-02	8.8063E-02	1.1079E-01	9.4314E-02	4.5966E-02	1.5880E-02	3.6307E-03	
+/-[j]	7.6717E-03	NA	3.4175E-03	6.8032E-03	1.3855E-02	9.6423E-03	5.0302E-03	1.7642E-03	6.4079E-04	
SegmentTotal										3.9693E-01
+/-[n]										2.0750E-02
Xe-132 (mol%)[d]	22.6	22.6	22.6	22.6	22.6	22.6	22.6	22.6	22.6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	3.8753E-04	0.0000E+00	7.8149E-02	1.8067E-01	2.2730E-01	1.9349E-01	9.4303E-02	3.2580E-02	7.4487E-03	
+/-[j]	1.5739E-02	NA	6.9844E-03	1.3885E-02	2.8368E-02	1.9724E-02	1.0293E-02	3.6104E-03	1.3133E-03	
SegmentTotal										8.1433E-01
+/-[n]										4.2471E-02
Xe-134 (mol%)[d]	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	25.6	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-134 (g)[k]	4.4564E-04	0.0000E+00	8.9866E-02	2.0775E-01	2.6138E-01	2.2250E-01	1.0844E-01	3.7464E-02	8.5655E-03	
+/-[j]	1.8099E-02	NA	8.0524E-03	1.6023E-02	3.2664E-02	2.2726E-02	1.1857E-02	4.1587E-03	1.5112E-03	
SegmentTotal										9.3642E-01
+/-[n]										4.8915E-02

Rod "L" 1400544 (SBI-3 C3)

	L-00	L-01	L-02	L-03	L-04	L-05	L-06	L-07	L-08	L-09
seg length (in)[a]	11.176	11.007	14.373	14.172	14.17	14.25	13.927	10.499	12.941	1.638
total length (in)										1.1815E+02
Xe-136 (mol%)[d]	40.7	40.7	40.7	40.7	40.7	40.7	40.7	40.7	40.7	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-136 (g)[k]	7.1909E-04	0.0000E+00	1.4501E-01	3.3523E-01	4.2177E-01	3.5903E-01	1.7498E-01	6.0453E-02	1.3821E-02	
+/-[j]	2.9204E-02	NA	1.2964E-02	2.5774E-02	5.2645E-02	3.6606E-02	1.9103E-02	6.7005E-03	2.4371E-03	
SegmentTotal										1.5110E+00
+/-[n]										7.8819E-02
Rod total										3.6657E+00
+/-[n]										1.0411E-01
shear gas (g)[e]	0	0	0.0004	0.0015	0.0022	0.0025	0.0007	0.0003	0.0003	
+/-[e]	0	0.0003	0.0003	0.0003	0.0004	0.0005	0.0003	0.0003	0.0003	
moles Xe (diss+pl)[d]	0.000013	0	0.002619	0.006051	0.007611	0.006475	0.003159	0.001091	0.000248	
+/-[d]	0.000001	0	0.000234	0.000465	0.000951	0.000661	0.000345	0.000121	0.000044	
Kr+Xe diss&pl (g)[d]	0.0022	0	0.4112	0.9508	1.1996	1.0265	0.4973	0.1722	0.0398	
+/-[d]	0.0001	0	0.0324	0.0645	0.1288	0.0915	0.0473	0.0171	0.0064	
moles Xe (tot)[o]	1.3000E-05	0	2.6215E-03	6.0605E-03	7.6250E-03	6.4908E-03	3.1634E-03	1.0929E-03	2.4987E-04	
+/-[p]	5.2797E-04	0	2.3401E-04	4.6500E-04	9.5101E-04	6.6101E-04	3.4501E-04	1.2102E-04	4.4042E-05	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project										
Cs-137 (atoms)[l]	NA	3.8080E+18	3.9250E+20	8.7130E+20	1.1660E+21	1.2680E+21	4.4470E+20	1.5580E+20	3.2090E+19	
+/-[l]	NA	1.1990E+16	1.1260E+18	2.5000E+18	3.3460E+18	3.6350E+18	1.2750E+18	4.5260E+17	9.2010E+16	
Cs-137 (g)[m]	NA	8.6561E-04	8.9221E-02	1.9806E-01	2.6505E-01	2.8823E-01	1.0109E-01	3.5416E-02	7.2945E-03	
+/-[m]	NA	2.7255E-06	2.5596E-04	5.6829E-04	7.6059E-04	8.2629E-04	2.8983E-04	1.0288E-04	2.0915E-05	
Total										9.8522E-01
+/-[n]										1.3209E-03
Ce-144 (atoms)[g]	NA	4.9060E+17	2.7450E+19	4.8590E+19	6.0730E+19	6.4920E+19	2.8980E+19	8.7540E+18	1.6150E+18	
+/-[g]	NA	3.6290E+15	2.0270E+17	3.5880E+17	4.4850E+17	4.7940E+17	2.1400E+17	6.4770E+16	1.1930E+16	
Ce-144 (g)[m]	NA	1.1723E-04	6.5591E-03	1.1610E-02	1.4511E-02	1.5512E-02	6.9247E-03	2.0917E-03	3.8590E-04	
+/-[m]	NA	8.6714E-07	4.8435E-05	8.5734E-05	1.0717E-04	1.1455E-04	5.1135E-05	1.5477E-05	2.8506E-06	
Total										5.7713E-02
+/-[n]										1.9279E-04

Rod "L" 1400544 (SBI-3 C3)

	L-00	L-01	L-02	L-03	L-04	L-05	L-06	L-07	L-08	L-09
seg length (in)[a]	11.176	11.007	14.373	14.172	14.17	14.25	13.927	10.499	12.941	1.638
total length (in)										1.1815E+02
Zr-95 (atoms)[h]	NA	5.3870E+15	2.4560E+17	3.7340E+17	5.4680E+17	4.1920E+17	1.7670E+17	2.7740E+16	4.3160E+15	
+/-[h]	NA	1.6110E+14	9.0000E+15	1.9010E+16	4.1060E+16	4.6580E+16	1.5310E+16	3.8210E+15	7.0910E+14	
Zr-95 (g)[m]	NA	8.4889E-07	3.8702E-05	5.8841E-05	8.6165E-05	6.6058E-05	2.7845E-05	4.3713E-06	6.8012E-07	
+/-[m]	NA	2.5386E-08	1.4182E-06	2.9956E-06	6.4703E-06	7.3401E-06	2.4126E-06	6.0212E-07	1.1174E-07	
Total										2.8351E-04
+/-[n]										1.0627E-05

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod L, 1400544, page 3
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod L, 1400544, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod L, 1400544, page 7
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod L, 1400544, page 10
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod L, 1400544, page 11
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod L, 1400544, page 12
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod L, 1400544, page 13
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod L, 1400544, page 14
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "M" 0504042 (St-1, 5L29)

	M-00	M-01	M-02	M-03	M-04	M-05	M-06	M-07
seg length (in)[a]	10.078	10.088	21.438	21.24	21.24	21.308	9.565	2.018
total length (in)								1.1698E+02
U-232 wt%[b]	0	0.042	0.0701	0.1417	0.1346	0.0437	0.0253	
+/-[b]	0	0.0013	0.0022	0.0044	0.0042	0.0014	0.0008	
U-232 g[i]	0.0000E+00	1.4414E-04	4.3676E-03	8.1992E-03	8.1110E-03	3.0991E-03	5.0054E-05	
+/-[j]	NA	4.4617E-06	1.3708E-04	2.5461E-04	2.5310E-04	9.9286E-05	1.5828E-06	
Segment Total								2.3971E-02
+/-[n]								3.9693E-04
U-233 wt%[b]	100	97.0789	87.5216	82.7315	84.0898	91.61	98.1378	
+/-[b]	0	0.0104	0.0061	0.0068	0.0066	0.0038	0.0183	
U-233 g[i]	4.0000E-05	3.3317E-01	5.4531E+00	4.7871E+00	5.0673E+00	6.4967E+00	1.9416E-01	
+/-[j]	1.0000E-05	1.0343E-04	1.3920E-03	1.3255E-03	1.3708E-03	1.5715E-03	7.7653E-05	
Segment Total								2.2331E+01
+/-[n]								2.8390E-03
U-234 wt%[b]	0	2.711	10.3344	13.8962	12.8481	7.0629	1.7575	
+/-[b]	0	0.0021	0.0019	0.0021	0.0018	0.0019	0.0022	
U-234 g[i]	0.0000E+00	9.3039E-03	6.4389E-01	8.0407E-01	7.7423E-01	5.0088E-01	3.4770E-03	
+/-[j]	NA	7.7000E-06	1.9752E-04	2.4489E-04	2.2790E-04	1.8001E-04	4.5230E-06	
Segment Total								2.7358E+00
+/-[n]								4.2826E-04
U-235 wt%[b]	0	0.1516	1.6115	2.6311	2.3806	0.92	0.0605	
+/-[b]	0	0.0073	0.0011	[illegible]	[illegible]	[illegible]	[illegible]	
U-235 g[i]	0.0000E+00	5.2028E-04	1.0040E-01	1.5224E-01	1.4346E-01	6.5243E-02	1.1969E-04	
+/-[j]	NA	2.5053E-05	2.7525E-04	2.6920E-04	2.6773E-04	1.6385E-04	2.5719E-05	
Segment Total								4.6199E-01
+/-[n]								4.9804E-04
U-236 wt%[b]	0	0.0035	0.1248	0.2597	0.2209	0.0575	0.0011	
+/-[b]	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0002	
U-236 g[i]	0.0000E+00	1.2012E-05	7.7757E-03	1.5027E-02	1.3312E-02	4.0777E-03	2.1762E-06	
+/-[j]	NA	3.4321E-07	6.5165E-06	7.0192E-06	6.9418E-06	7.1579E-06	3.9568E-07	
Segment Total								4.0206E-02
+/-[n]								1.3836E-05

Rod "M" 0504042 (SI-1, 5L29)

	M-00	M-01	M-02	M-03	M-04	M-05	M-06	M-07
seg length (in)[a]	10.078	10.088	21.438	21.24	21.24	21.308	9.565	2.018
total length (in)								1.1698E+02
U-238 wt%[b]	0	0.0129	0.3375	0.3397	0.326	0.3059	0.0177	
+/-[b]	0	0.0074	0.0045	0.0047	0.0045	0.0024	0.0131	
U-238 g[j]	0.0000E+00	4.4272E-05	2.1028E-02	1.9656E-02	1.9645E-02	2.1693E-02	3.5018E-05	
+/-[j]	NA	2.5396E-05	2.8042E-04	2.7200E-04	2.7122E-04	1.7028E-04	2.5917E-05	
Segment Total								8.2102E-02
+/-[n]								5.0645E-04
tot U[c]	0.00007	0.34319	6.23052	5.78628	6.02603	7.09168	0.19784	
+/-[c]	0.00001	0.0001	0.00153	0.00153	0.00156	0.00169	0.00007	
Kr-82 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0	0	0	0	0	0	0	
Kr-82 (g)[k]	8.1913E-07	0.0000E+00	2.5197E-04	2.9777E-04	2.5897E-04	1.7157E-04	0.0000E+00	
+/-[j]	0.0000E+00	NA	2.1790E-05	3.1786E-05	3.1130E-05	2.0151E-05	NA	
Segment Total								9.8110E-04
+/-[n]								5.3481E-05
Kr-83 (mol%)[d]	14.9	14.9	14.9	14.9	14.9	14.9	14.9	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-83 (g)[k]	6.1771E-05	0.0000E+00	1.9001E-02	2.2455E-02	1.9529E-02	1.2938E-02	0.0000E+00	
+/-[j]	4.1457E-07	NA	1.6481E-03	2.4017E-03	2.3511E-03	1.5221E-03	NA	
Segment Total								7.3985E-02
+/-[n]								4.0409E-03
Kr-84 (mol%)[d]	30.8	30.8	30.8	30.8	30.8	30.8	30.8	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-84 (g)[k]	1.2922E-04	0.0000E+00	3.9750E-02	4.6975E-02	4.0855E-02	2.7066E-02	0.0000E+00	
+/-[j]	4.1956E-07	NA	3.4399E-03	5.0167E-03	4.9127E-03	3.1802E-03	NA	
Segment Total								1.5478E-01
+/-[n]								8.4409E-03

Rod "M" 0504042 (SI-1, 5L29)

	M-00	M-01	M-02	M-03	M-04	M-05	M-06	M-07
seg length (in)[a]	10.078	10.088	21.438	21.24	21.24	21.308	9.565	2.018
total length (in)								1.1698E+02
Kr-85 (mol%)[d]	5.7	5.7	5.7	5.7	5.7	5.7	5.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	2.4200E-05	0.0000E+00	7.4441E-03	8.7972E-03	7.6510E-03	5.0687E-03	0.0000E+00	
+/-[j]	4.2456E-07	NA	6.5686E-04	9.5166E-04	9.2942E-04	6.0194E-04	NA	
Segment Total								2.8985E-02
+/-[n]								1.6010E-03
Kr-86 (mol%)[d]	48.5	48.5	48.5	48.5	48.5	48.5	48.5	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-86 (g)[k]	2.0833E-04	0.0000E+00	6.4085E-02	7.5733E-02	6.5866E-02	4.3636E-02	0.0000E+00	
+/-[j]	4.2955E-07	NA	5.5434E-03	8.0857E-03	7.9184E-03	5.1259E-03	NA	
Segment Total								2.4953E-01
+/-[n]								1.3605E-02
Rod Total								5.0825E-01
+/-[n]								1.6590E-02
shear gas (g)[e]	0	0.0001	0.0031	0.0071	0.006	0.002	0	
+/-[e]	0	0.0003	0.0006	0.0014	0.0012	0.0004	0.0003	
moles Kr (diss+pl)[d]	0.000005	0	0.001533	0.001806	0.001571	0.001044	0	
+/-[d]	0	0	0.000133	0.000194	0.00019	0.000123	0	
Kr+Xe diss&pl (g)[d]	0.0029	0.0112	0.9443	1.1056	0.9644	0.641	0.009	
+/-[d]	0.0001	0.0112	0.0549	0.0881	0.066	0.0425	0.009	
moles kr (tot)[o]	5.0000E-06	0.0000E+00	1.5380E-03	1.8176E-03	1.5808E-03	1.0473E-03	0.0000E+00	
+/-[p]	0.0000E+00	0.0000E+00	1.3300E-04	1.9402E-04	1.9001E-04	1.2300E-04	0.0000E+00	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	
Xe-128 (g)[k]	2.4302E-06	1.0711E-05	7.7828E-04	9.1317E-04	7.9665E-04	5.2797E-04	8.5695E-06	
+/-[j]	1.2790E-07	1.0621E-05	5.1164E-05	8.2509E-05	6.0892E-05	3.9268E-05	8.5695E-06	
SegmentTotal								3.0378E-03
+/-[n]								1.2191E-04

Rod "M" 0504042 (SI-1, 5L29)

	M-00	M-01	M-02	M-03	M-04	M-05	M-06	M-07
seg length (in)[a]	10.078	10.088	21.438	21.24	21.24	21.308	9.565	2.018
total length (in)								1.1698E+02
Xe-130 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	
Xe-130 (g)[k]	2.4682E-06	1.0878E-05	7.9045E-04	9.2745E-04	8.0911E-04	5.3622E-04	8.7035E-06	
+/-[j]	1.2990E-07	1.0787E-05	5.1964E-05	8.3799E-05	6.1844E-05	3.9882E-05	8.7035E-06	
SegmentTotal								3.0853E-03
+/-[n]								1.2381E-04
Xe-131 (mol%)[d]	10.7	10.7	10.7	10.7	10.7	10.7	10.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	2.6613E-04	1.1729E-03	8.5230E-02	1.0000E-01	8.7242E-02	5.7818E-02	9.3846E-04	
+/-[j]	1.4226E-05	1.1631E-03	5.6594E-03	9.0838E-03	6.7180E-03	4.3341E-03	9.3850E-04	
SegmentTotal								3.3267E-01
+/-[n]								1.3442E-02
Xe-132 (mol%)[d]	23.6	23.6	23.6	23.6	23.6	23.6	23.6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	5.9146E-04	2.6068E-03	1.8942E-01	2.2225E-01	1.9389E-01	1.2850E-01	2.0857E-03	
+/-[j]	3.1230E-05	2.5849E-03	1.2478E-02	2.0103E-02	1.4843E-02	9.5726E-03	2.0857E-03	
SegmentTotal								7.3934E-01
+/-[n]								2.9712E-02
Xe-134 (mol%)[d]	25.7	25.7	25.7	25.7	25.7	25.7	25.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-134 (g)[k]	6.5386E-04	2.8818E-03	2.0940E-01	2.4570E-01	2.1435E-01	1.4205E-01	2.3057E-03	
+/-[j]	3.4508E-05	2.8576E-03	1.3790E-02	2.2220E-02	1.6405E-02	1.0580E-02	2.3057E-03	
SegmentTotal								8.1734E-01
+/-[n]								3.2840E-02

Rod "M" 0504042 (SI-1, 5L29)

	M-00	M-01	M-02	M-03	M-04	M-05	M-06	M-07
seg length (in)[a]	10.078	10.088	21.438	21.24	21.24	21.308	9.565	2.018
total length (in)								1.1698E+02
Xe-136 (mol%)[d]	39.8	39.8	39.8	39.8	39.8	39.8	39.8	
+/-[d]	0.1	39.8	39.8	39.8	39.8	39.8	39.8	
Xe-136 (g)[k]	1.0277E-03	4.5296E-03	3.2914E-01	3.8619E-01	3.3691E-01	2.2328E-01	3.6241E-03	
+/-[j]	5.4153E-05	6.3790E-03	3.2985E-01	3.8776E-01	3.3789E-01	2.2390E-01	5.1253E-03	
SegmentTotal								1.2847E+00
+/-[n]								6.5079E-01
Rod total								3.1802E+00
+/-[n]								6.5243E-01
shear gas (g)[e]	0	0.0001	0.0031	0.0071	0.006	0.002	0	
+/-[e]	0	0.0003	0.0006	0.0014	0.0012	0.0004	0.0003	
moles Xe (diss+pl)[d]	0.000019	0.000083	0.006065	0.007094	0.00619	0.004115	0.000067	
+/-[d]	0.000001	0.000083	0.0004	0.000645	0.000476	0.000307	0.000067	
Kr+Xe diss&pl (g)[d]	0.0029	0.0112	0.9443	1.1056	0.9644	0.641	0.009	
+/-[d]	0.0001	0.0112	0.0549	0.0881	0.066	0.0425	0.009	
moles Xe (tot)[o]	1.9000E-05	8.3741E-05	6.0849E-03	7.1396E-03	6.2285E-03	4.1278E-03	6.7000E-05	
+/-[p]	1.0000E-06	8.3036E-05	4.0002E-04	6.4509E-04	4.7608E-04	3.0701E-04	6.7000E-05	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project								
Cs-137 (atoms)[l]	ND	1.0800E+19	7.9880E+20	1.0550E+21	1.0030E+21	5.6080E+20	3.9940E+18	
+/-[l]	NA	5.6480E+16	3.5060E+18	5.3850E+18	5.1180E+18	2.9430E+18	2.2400E+16	
Cs-137 (g)[m]	NA	2.4550E-03	1.8158E-01	2.3982E-01	2.2800E-01	1.2748E-01	9.0789E-04	
+/-[m]	NA	1.2839E-05	7.9696E-04	1.2241E-03	1.1634E-03	6.6899E-04	5.0918E-06	
Total								7.8023E-01
+/-[n]								1.9836E-03
Ce-144 (atoms)[g]	ND	3.3580E+17	2.0240E+19	3.9190E+19	5.2520E+19	4.5750E+19	6.2190E+17	
+/-[g]	NA	2.6120E+15	1.3860E+17	2.9100E+17	4.0380E+17	3.5190E+17	4.8400E+15	
Ce-144 (g)[m]	NA	8.0239E-05	4.8363E-03	9.3644E-03	1.2550E-02	1.0932E-02	1.4860E-04	
+/-[m]	NA	6.2413E-07	3.3118E-05	6.9534E-05	9.6487E-05	8.4086E-05	1.1565E-06	
Total								3.7911E-02
+/-[n]								1.4938E-04

Rod "M" 0504042 (SI-1, 5L29)

	M-00	M-01	M-02	M-03	M-04	M-05	M-06	M-07
seg length (in)[a]	10.078	10.088	21.438	21.24	21.24	21.308	9.565	2.018
total length (in)								1.1698E+02
Zr-95 (atoms)[h]	ND	ND	ND	2.6190E+17	4.6540E+17	3.9990E+17	8.2920E+15	
+/-[h]	NA	NA	NA	2.9000E+16	5.5950E+16	2.8960E+16	4.7690E+14	
Zr-95 (g)[m]	NA	NA	NA	4.1270E-05	7.3338E-05	6.3017E-05	1.3067E-06	
+/-[m]	NA	NA	NA	4.5698E-06	8.8167E-06	4.5635E-06	7.5150E-08	
Total								1.7893E-04
+/-[n]								1.0929E-05

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod M, 0504042, page 4
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod M, 0504042, page 7
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod M, 0504042, page 8
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod M, 0504042, page 11
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod M, 0504042, page 12
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod M, 0504042, page 13
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod M, 0504042, page 14
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod M, 0504042, page 15
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "N" 0507057 (SI-1, 5C10)

	N-00	N-01	N-02	N-03	N-04	N-05	N-06	N-07
seg length (in)[a]	10.228	10.08	21.368	21.171	21.169	21.243	9.644	2.065
total length (in)								1.1697E+02
U-232 wt%[b]	0	0.04	0.055	0.1181	0.1228	0.0413	0.0261	
+/-[b]	0	0.0012	0.0017	0.0037	0.0038	0.0013	0.0008	
U-232 g[i]	0.0000E+00	1.3013E-04	3.9700E-03	7.7510E-03	7.9892E-03	3.0539E-03	4.9728E-05	
+/-[j]	NA	3.9041E-06	1.2271E-04	2.4284E-04	2.4723E-04	9.6130E-05	1.5245E-06	
Segment Total								2.2944E-02
+/-[n]								3.8001E-04
U-233 wt%[b]	100	97.3294	90.9788	86.2675	85.9847	92.2898	98.2295	
+/-[b]	0	0.0129	0.0049	0.0059	0.005	0.0062	0.0215	
U-233 g[i]	4.0000E-05	3.1664E-01	6.5670E+00	5.6618E+00	5.5940E+00	6.8243E+00	1.8716E-01	
+/-[j]	1.0000E-05	9.7131E-05	1.4892E-03	1.3507E-03	1.3052E-03	1.7055E-03	1.0643E-04	
Segment Total								2.5151E+01
+/-[n]								2.9454E-03
U-234 wt%[b]	0	2.488	7.5417	11.1477	11.3575	6.4854	1.6675	
+/-[b]	0	0.0009	0.0009	0.0012	0.0011	0.0009	0.0009	
U-234 g[i]	0.0000E+00	8.0942E-03	5.4437E-01	7.3163E-01	7.3890E-01	4.7956E-01	3.1771E-03	
+/-[j]	NA	3.6861E-06	1.3638E-04	1.8483E-04	1.8165E-04	1.3325E-04	2.3919E-06	
Segment Total								2.5057E+00
+/-[n]								3.2177E-04
U-235 wt%[b]	0	0.1296	1.06	2.0017	2.0629	0.8391	0.0548	
+/-[b]	0	0.0094	0.0036	0.004	0.0031	0.0046	0.0155	
U-235 g[i]	0.0000E+00	4.2163E-04	7.6513E-02	1.3137E-01	1.3421E-01	6.2046E-02	1.0441E-04	
+/-[j]	NA	3.0581E-05	2.6040E-04	2.6423E-04	2.0395E-04	3.4047E-04	2.9532E-05	
Segment Total								4.0467E-01
+/-[n]								5.4493E-04
U-236 wt%[b]	0	0.0026	0.0663	0.1621	0.1711	0.0495	0.0009	
+/-[b]	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
U-236 g[i]	0.0000E+00	8.4586E-06	4.7856E-03	1.0639E-02	1.1131E-02	3.6602E-03	1.7148E-06	
+/-[j]	NA	3.2534E-07	7.2947E-06	6.9990E-06	6.9751E-06	7.4467E-06	1.9053E-07	
Segment Total								[illegible]
+/-[n]								1.4368E-05

Rod "N" 0507057 (SI-1, 5C10)

	N-00	N-01	N-02	N-03	N-04	N-05	N-06	N-07
seg length (in)[a]	10.228	10.08	21.368	21.171	21.169	21.243	9.644	2.065
total length (in)								1.1697E+02
U-238 wt%[b]	0	0.0104	0.2982	0.3029	0.301	0.2949	0.0212	
+/-[b]	0	0.0093	0.0035	0.0039	0.0029	0.0045	0.0155	
U-238 g[i]	0.0000E+00	3.3834E-05	2.1525E-02	1.9880E-02	1.9583E-02	2.1806E-02	4.0392E-05	
+/-[j]	NA	3.0256E-05	2.5268E-04	2.5600E-04	1.8872E-04	3.3279E-04	2.9532E-05	
Segment Total								8.2867E-02
+/-[n]								5.2682E-04
tot U[c]	0.00009	0.32533	7.21817	6.56307	6.50583	7.39439	0.19053	
+/-[c]	0.00001	0.00009	0.00159	0.0015	0.00147	0.00178	0.0001	
Kr-82 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0	0	0	0	0	0	0	
Kr-82 (g)[k]	4.9148E-07	0.0000E+00	2.0637E-04	2.1579E-04	2.7483E-04	1.6324E-04	1.1110E-07	
+/-[j]	0.0000E+00	NA	2.4247E-05	2.9818E-05	3.0474E-05	1.9168E-05	8.4840E-08	
Segment Total								8.6083E-04
+/-[n]								5.2660E-05
Kr-83 (mol%)[d]	15.7	15.7	15.7	15.7	15.7	15.7	15.7	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-83 (g)[k]	3.9053E-05	0.0000E+00	1.6398E-02	1.7147E-02	2.1838E-02	1.2971E-02	8.8280E-06	
+/-[j]	4.9748E-07	NA	1.9379E-03	2.3794E-03	2.4373E-03	1.5320E-03	6.7422E-06	
Segment Total								6.8401E-02
+/-[n]								4.2077E-03
Kr-84 (mol%)[d]	29.9	29.9	29.9	29.9	29.9	29.9	29.9	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-84 (g)[k]	7.5269E-05	0.0000E+00	3.1605E-02	3.3048E-02	4.2090E-02	2.4999E-02	1.7015E-05	
+/-[j]	2.5173E-07	NA	3.7148E-03	4.5679E-03	4.6691E-03	2.9367E-03	1.2993E-05	
Segment Total								1.3183E-01
+/-[n]								8.0678E-03

Rod "N" 0507057 (SI-1, 5C10)

	N-00	N-01	N-02	N-03	N-04	N-05	N-06	N-07
seg length (in)[a]	10.228	10.08	21.368	21.171	21.169	21.243	9.644	2.065
total length (in)								1.1697E+02
Kr-85 (mol%)[d]	5.7	5.7	5.7	5.7	5.7	5.7	5.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	1.4520E-05	0.0000E+00	6.0968E-03	6.3753E-03	8.1196E-03	4.8225E-03	3.2823E-06	
+/-[j]	2.5474E-07	NA	7.2427E-04	8.8801E-04	9.1150E-04	5.7258E-04	2.5071E-06	
Segment Total								2.5432E-02
+/-[n]								1.5722E-03
Kr-86 (mol%)[d]	48.5	48.5	48.5	48.5	48.5	48.5	48.5	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-86 (g)[k]	1.2500E-04	0.0000E+00	5.2486E-02	5.4883E-02	6.9900E-02	4.1516E-02	2.8257E-05	
+/-[j]	2.5773E-07	NA	6.1677E-03	7.5846E-03	7.7518E-03	4.8759E-03	2.1578E-05	
Segment Total								2.1894E-01
+/-[n]								1.3395E-02
Rod Total								4.4547E-01
+/-[n]								1.6270E-02
shear gas (g)[e]	0	0	0.0016	0.0041	0.005	0.002	0.0004	
+/-[e]	0	0.0003	0.0003	0.0008	0.001	0.0004	0.0003	
moles Kr (diss+pl)[d]	0.000003	0	0.001257	0.00131	0.001669	0.000993	0	
+/-[d]	0	0	0.000148	0.000182	0.000186	0.000117	0	
Kr+Xe diss&pl (g)[d]	0.0016	0.0164	0.7518	0.746	0.9713	0.5857	0	
+/-[d]	0.0001	0.0164	0.0417	0.0989	0.0845	0.0481	0	
moles kr (tot)[o]	3.0000E-06	0.0000E+00	1.2597E-03	1.3172E-03	1.6776E-03	9.9639E-04	6.7816E-07	
+/-[p]	0.0000E+00	0.0000E+00	1.4800E-04	1.8201E-04	1.8601E-04	1.1700E-04	5.1786E-07	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	
Xe-128 (g)[k]	1.2790E-06	1.5604E-05	6.1627E-04	6.0844E-04	7.9490E-04	4.7961E-04	3.2643E-07	
+/-[j]	0.0000E+00	1.5604E-05	3.7860E-05	9.3118E-05	7.9050E-05	4.4768E-05	2.4818E-07	
SegmentTotal								2.5164E-03
+/-[n]								1.3639E-04

Rod "N" 0507057 (SI-1, 5C10)

	N-00	N-01	N-02	N-03	N-04	N-05	N-06	N-07
seg length (in)[a]	10.228	10.08	21.368	21.171	21.169	21.243	9.644	2.065
total length (in)								1.1697E+02
Xe-130 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	
Xe-130 (g)[k]	1.2990E-06	1.5848E-05	6.2591E-04	6.1795E-04	8.0733E-04	4.8711E-04	3.3153E-07	
+/-[j]	0.0000E+00	1.5848E-05	3.8452E-05	9.4575E-05	8.0286E-05	4.5468E-05	2.5206E-07	
SegmentTotal								2.5558E-03
+/-[n]								1.3852E-04
Xe-131 (mol%)[d]	11.8	11.8	11.8	11.8	11.8	11.8	11.8	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	1.5447E-04	1.8845E-03	7.4426E-02	7.3480E-02	9.5999E-02	5.7922E-02	3.9423E-05	
+/-[j]	1.3091E-06	1.8846E-03	4.6157E-03	1.1263E-02	9.5815E-03	5.4288E-03	2.9974E-05	
SegmentTotal								3.0391E-01
+/-[n]								1.6522E-02
Xe-132 (mol%)[d]	24	24	24	24	24	24	24	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	3.1657E-04	3.8622E-03	1.5253E-01	1.5059E-01	1.9674E-01	1.1871E-01	8.0794E-05	
+/-[j]	1.3190E-06	3.8622E-03	9.3922E-03	2.3056E-02	1.9583E-02	1.1091E-02	6.1426E-05	
SegmentTotal								6.2283E-01
+/-[n]								3.3782E-02
Xe-134 (mol%)[d]	26.6	26.6	26.6	26.6	26.6	26.6	26.6	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-134 (g)[k]	3.5619E-04	4.3455E-03	1.7162E-01	1.6944E-01	2.2136E-01	1.3356E-01	9.0905E-05	
+/-[j]	1.3391E-06	4.3455E-03	1.0563E-02	2.5940E-02	2.2030E-02	1.2477E-02	6.9114E-05	
SegmentTotal								7.0078E-01
+/-[n]								3.8004E-02

Rod "N" 0507057 (SI-1, 5C10)

	N-00	N-01	N-02	N-03	N-04	N-05	N-06	N-07
seg length (in)[a]	10.228	10.08	21.368	21.171	21.169	21.243	9.644	2.065
total length (in)								1.1697E+02
Xe-136 (mol%)[d]	37.5	37.5	37.5	37.5	37.5	37.5	37.5	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-136 (g)[k]	5.0965E-04	6.2178E-03	2.4556E-01	2.4244E-01	3.1674E-01	1.9111E-01	1.3007E-04	
+/-[j]	2.7181E-06	6.2178E-03	1.5143E-02	3.7127E-02	3.1544E-02	1.7868E-02	9.8892E-05	
SegmentTotal								1.0027E+00
+/-[n]								5.4412E-02
Rod total								2.6353E+00
+/-[n]								7.6284E-02
shear gas (g)[e]	0	0	0.0016	0.0041	0.005	0.002	0.0004	
+/-[e]	0	0.0003	0.0003	0.0008	0.001	0.0004	0.0003	
moles Xe (diss+pl)[d]	0.00001	0.000122	0.004808	0.004731	0.006183	0.003737	0	
+/-[d]	0	0.000122	0.000296	0.000728	0.000618	0.00035	0	
Kr+Xe diss&pl (g)[d]	0.0016	0.0164	0.7518	0.746	0.9713	0.5857	0	
+/-[d]	0.0001	0.0164	0.0417	0.0989	0.0845	0.0481	0	
moles Xe (tot)[o]	1.0000E-05	1.2200E-04	4.8182E-03	4.7570E-03	6.2148E-03	3.7498E-03	2.5522E-06	
+/-[p]	0.0000E+00	1.2200E-04	2.9601E-04	7.2804E-04	6.1805E-04	3.5001E-04	1.9403E-06	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project								
Cs-137 (atoms)[l]	NA	9.3490E+18	5.9200E+20	8.9150E+20	9.1270E+20	5.1590E+20	3.6830E+18	
+/-[l]	NA	2.7340E+16	1.6330E+18	2.4660E+18	2.6410E+18	1.5560E+18	1.3090E+16	
Cs-137 (g)[m]	NA	2.1252E-03	1.3457E-01	2.0265E-01	2.0747E-01	1.1727E-01	8.3720E-04	
+/-[m]	NA	6.2148E-06	3.7120E-04	5.6056E-04	6.0034E-04	3.5370E-04	2.9755E-06	
Total								6.6492E-01
+/-[n]								9.6828E-04
Ce-144 (atoms)[g]	NA	2.9230E+17	1.6300E+19	3.5170E+19	4.8440E+19	4.2250E+19	5.7740E+17	
+/-[g]	NA	2.0030E+15	1.1050E+17	2.3870E+17	3.3830E+17	2.8650E+17	3.8640E+15	
Ce-144 (g)[m]	NA	6.9844E-05	3.8948E-03	8.4038E-03	1.1575E-02	1.0096E-02	1.3797E-04	
+/-[m]	NA	4.7861E-07	2.6404E-05	5.7037E-05	8.0836E-05	6.8459E-05	9.2329E-07	
Total								3.4177E-02
+/-[n]								1.2318E-04

Rod "N" 0507057 (SI-1, 5C10)

	N-00	N-01	N-02	N-03	N-04	N-05	N-06	N-07
seg length (in)[a]	10.228	10.08	21.368	21.171	21.169	21.243	9.644	2.065
total length (in)								1.1697E+02
Zr-95 (atoms)[h]	NA	ND	ND	2.0490E+17	3.9550E+17	4.2690E+17	8.4410E+15	
+/-[h]	NA	NA	NA	3.6920E+16	5.3040E+16	3.2790E+16	4.6190E+14	
Zr-95 (g)[m]	NA	NA	NA	3.2288E-05	6.2323E-05	6.7271E-05	1.3301E-06	
+/-[m]	NA	NA	NA	5.8179E-06	8.3581E-06	5.1671E-06	7.2787E-08	
Total								1.6321E-04
+/-[n]								1.1420E-05

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod N, 0507057, page 4
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod N, 0507057, page 7
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod N, 0507057, page 8
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod N, 0507057, page 11
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod N, 0507057, page 12
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod N, 0507057, page 13
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod N, 0507057, page 14
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod N, 0507057, page 15
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "O" 0201562 (SI-1, 2P39)

	O-00	O-01	O-02	O-03	O-04	O-05	O-06	O-07
seg length (in)[a]	11.527	17.912	17.606	17.409	21.29	21.163	8.917	1.038
total length (in)								1.1686E+02
U-232 wt%[b]	0	0.0926	0.2163	0.2783	0.1645	0.056	0.0255	
+/-[b]	0	0.0029	0.0067	0.0086	0.0051	0.0017	0.0008	
U-232 g[j]	0.0000E+00	8.7009E-04	4.1808E-03	5.9158E-03	7.9416E-03	3.1464E-03	5.1237E-05	
+/-[j]	NA	2.7250E-05	1.2951E-04	1.8298E-04	2.4622E-04	9.5519E-05	1.6076E-06	
Segment Total								2.2106E-02
+/-[n]								3.4749E-04
U-233 wt%[b]	100	94.5383	88.1054	86.0389	80.8887	89.8139	98.0189	
+/-[b]	0	0.0063	0.0096	0.009	0.0068	0.007	0.0197	
U-233 g[j]	4.0000E-05	8.8830E-01	1.7030E+00	1.8289E+00	3.9051E+00	5.0462E+00	1.9695E-01	
+/-[j]	1.0000E-05	2.2535E-04	5.4366E-04	2.4253E-03	1.0323E-03	1.4034E-03	8.7839E-05	
Segment Total								1.3568E+01
+/-[n]								3.0449E-03
U-234 wt%[b]	0	4.8371	9.8257	11.3124	15.1822	8.48	1.8673	
+/-[b]	0	0.001	0.0015	0.0015	0.0017	0.0012	0.0012	
U-234 g[j]	0.0000E+00	4.5450E-02	1.8992E-01	2.4047E-01	7.3296E-01	4.7645E-01	3.7520E-03	
+/-[j]	NA	1.4562E-05	6.3940E-05	3.1947E-04	2.0120E-04	1.4396E-04	2.8364E-06	
Segment Total								1.6890E+00
+/-[n]								4.0937E-04
U-235 wt%[b]	0	0.5023	1.7012	2.148	3.0086	1.1655	0.0665	
+/-[b]	0	0.0042	0.006	0.004	0.0045	0.0053	0.0142	
U-235 g[j]	0.0000E+00	4.7197E-03	3.2882E-02	4.5660E-02	1.4525E-01	6.5484E-02	1.3362E-04	
+/-[j]	NA	3.9481E-05	1.1639E-04	1.0427E-04	2.2028E-04	2.9829E-04	2.8532E-05	
Segment Total								2.9413E-01
+/-[n]								4.0533E-04
U-236 wt%[b]	0	0.0237	0.1469	0.2158	0.3271	0.073	0.0011	
+/-[b]	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
U-236 g[j]	0.0000E+00	2.2269E-04	2.8394E-03	4.5872E-03	1.5792E-02	4.1015E-03	2.2102E-06	
+/-[j]	NA	9.4120E-07	2.1123E-06	6.4258E-06	6.2428E-06	5.7242E-06	2.0093E-07	
Segment Total								2.75[illegible]E-02
+/-[n]								1.0882E-05

Rod "O" 0201562 (SI-1, 2P39)

	O-00	O-01	O-02	O-03	O-04	O-05	O-06	O-07
seg length (in)[a]	11.527	17.912	17.606	17.409	21.29	21.163	8.917	1.038
total length (in)								1.1686E+02
U-238 wt%[b]	0	0.0059	0.0045	0.0065	0.4288	0.4117	0.0206	
+/-[b]	0	0.0042	0.006	0.004	0.0046	0.0053	0.0142	
U-238 g[i]	0.0000E+00	5.5438E-05	8.6980E-05	1.3817E-04	2.0701E-02	2.3131E-02	4.1392E-05	
+/-[j]	NA	3.9464E-05	1.1597E-04	8.5028E-05	2.2214E-04	2.9785E-04	2.8532E-05	
Segment Total								4.4155E-02
+/-[n]								4.0138E-04
tot U[c]	0.00015	0.93962	1.93288	2.12569	4.82775	5.61852	0.20093	
+/-[c]	0.00001	0.00023	0.00058	0.00281	0.00121	0.0015	0.00008	
Kr-82 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0	0	0	0	0	0	0	
Kr-82 (g)[k]	3.2765E-07	1.7229E-05	5.8050E-05	7.9274E-05	3.2903E-04	1.6849E-04	0.0000E+00	
+/-[j]	0.0000E+00	2.1313E-06	7.0451E-06	1.9660E-05	4.8008E-05	1.9660E-05	NA	
Segment Total								6.5240E-04
+/-[n]								5.5964E-05
Kr-83 (mol%)[d]	15.2	15.2	15.2	15.2	15.2	15.2	15.2	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-83 (g)[k]	2.5206E-05	1.3254E-03	4.4657E-03	6.0984E-03	2.5312E-02	1.2962E-02	0.0000E+00	
+/-[j]	1.6583E-07	1.6419E-04	5.4277E-04	1.5129E-03	3.6969E-03	1.5148E-03	NA	
Segment Total								5.0188E-02
+/-[n]								4.3096E-03
Kr-84 (mol%)[d]	30.4	30.4	30.4	30.4	30.4	30.4	30.4	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-84 (g)[k]	5.1018E-05	2.6827E-03	9.0388E-03	1.2344E-02	5.1233E-02	2.6235E-02	0.0000E+00	
+/-[j]	1.6782E-07	3.3198E-04	1.0974E-03	3.0614E-03	7.4771E-03	3.0624E-03	NA	
Segment Total								1.0158E-01
+/-[n]								8.7162E-03

Rod "O" 0201562 (SI-1, 2P39)

	O-00	O-01	O-02	O-03	O-04	O-05	O-06	O-07
seg length (in)[a]	11.527	17.912	17.606	17.409	21.29	21.163	8.917	1.038
total length (in)								1.1686E+02
Kr-85 (mol%)[d]	5.7	5.7	5.7	5.7	5.7	5.7	5.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	9.6800E-06	5.0900E-04	1.7150E-03	2.3420E-03	9.7207E-03	4.9778E-03	0.0000E+00	
+/-[j]	1.6982E-07	6.3596E-05	2.1030E-04	5.8226E-04	1.4285E-03	5.8735E-04	NA	
Segment Total								1.9274E-02
+/-[n]								1.6652E-03
Kr-86 (mol%)[d]	48.7	48.7	48.7	48.7	48.7	48.7	48.7	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-86 (g)[k]	8.3677E-05	4.4000E-03	1.4825E-02	2.0245E-02	8.4029E-02	4.3029E-02	0.0000E+00	
+/-[j]	3.4364E-07	5.4460E-04	1.8002E-03	5.0214E-03	1.2265E-02	5.0239E-03	NA	
Segment Total								1.6661E-01
+/-[n]								1.4298E-02
Rod Total								3.3831E-01
+/-[n]								1.7371E-02
shear gas (g)[e]	0	0.0001	0.000[illegible]	[illegible]013	[illegible]	0.0020	0.0002	
+/-[e]	0	0.0003	0.0003	0.0003	0.0022	0.0005	0.0003	
moles Kr (diss+pl)[d]	0.000002	0.000105	0.000353	0.000482	0.001991	0.001024	0	
+/-[d]	0	0.000013	0.000043	0.00012	0.000293	0.00012	0	
Kr+Xe diss&pl (g)[d]	0.0013	0.0635	0.2116	0.3319	1.2697	0.5963	0.0146	
+/-[d]	0.0001	0.0054	0.0198	0.0417	0.1592	0.0496	0.0146	
moles kr (tot)[o]	2.0000E-06	1.0517E-04	3.5433E-04	4.8389E-04	2.0084E-03	1.0285E-03	0.0000E+00	
+/-[p]	0.0000E+00	1.3009E-05	4.3003E-05	1.2000E-04	2.9304E-04	1.2000E-04	0.0000E+00	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	
Xe-128 (g)[k]	1.0232E-06	5.2139E-05	1.7371E-04	3.0637E-04	1.0577E-03	4.8738E-04	1.4132E-05	
+/-[j]	0.0000E+00	4.9943E-06	1.8548E-05	3.8501E-05	1.4980E-04	4.6176E-05	1.3947E-05	
SegmentTotal								2.0925E-03
+/-[n]								1.6315E-04

Rod "O" 0201562 (SI-1, 2P39)

	O-00	O-01	O-02	O-03	O-04	O-05	O-06	O-07
seg length (in)[a]	11.527	17.912	17.606	17.409	21.29	21.163	8.917	1.038
total length (in)								1.1686E+02
Xe-130 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0	0	0	0	0	0	0	
Xe-130 (g)[k]	2.0785E-06	1.0591E-04	3.5285E-04	6.2233E-04	2.1485E-03	9.9001E-04	2.8707E-05	
+/-[j]	0.0000E+00	1.0145E-05	3.7676E-05	7.8205E-05	3.0428E-04	9.3796E-05	2.8330E-05	
SegmentTotal								4.2504E-03
+/-[n]								3.3140E-04
Xe-131 (mol%)[d]	10.9	10.9	10.9	10.9	10.9	10.9	10.9	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	1.1415E-04	5.8165E-03	1.9378E-02	3.4178E-02	1.1800E-01	5.4371E-02	1.5766E-03	
+/-[j]	1.0472E-06	5.5970E-04	2.0768E-03	4.3065E-03	1.6746E-02	5.1754E-03	1.5560E-03	
SegmentTotal								2.3343E-01
+/-[n]								1.8243E-02
Xe-132 (mol%)[d]	22.9	22.9	22.9	22.9	22.9	22.9	22.9	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	2.4165E-04	1.2313E-02	4.1023E-02	7.2354E-02	2.4979E-01	1.1510E-01	3.3376E-03	
+/-[j]	1.0552E-06	1.1807E-03	4.3840E-03	9.0979E-03	3.5393E-02	1.0917E-02	3.2938E-03	
SegmentTotal								4.9417E-01
+/-[n]								3.8550E-02
Xe-134 (mol%)[d]	25	25	25	25	25	25	25	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-134 (g)[k]	2.6781E-04	1.3646E-02	4.5465E-02	8.0187E-02	2.7684E-01	1.2756E-01	3.6989E-03	
+/-[j]	1.0712E-06	1.3083E-03	4.8580E-03	1.0082E-02	3.9222E-02	1.2096E-02	3.6504E-03	
SegmentTotal								5.4767E-01
+/-[n]								4.2720E-02

Rod "O" 0201562 (SI-1, 2P39)

	O-00	O-01	O-02	O-03	O-04	O-05	O-06	O-07
seg length (in)[a]	11.527	17.912	17.606	17.409	21.29	21.163	8.917	1.038
total length (in)								1.1686E+02
Xe-136 (mol%)[d]	41	41	41	41	41	41	41	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-136 (g)[k]	4.4578E-04	2.2715E-02	7.5677E-02	1.3347E-01	4.6080E-01	2.1233E-01	6.1569E-03	
+/-[j]	1.0873E-06	2.1765E-03	8.0826E-03	1.6776E-02	6.5269E-02	2.0123E-02	6.0761E-03	
SegmentTotal								9.1160E-01
+/-[n]								7.1088E-02
Rod total								2.1932E+00
+/-[n]								9.3260E-02
shear gas (g)[e]	0	0.0001	0.0008	0.0013	0.0111	0.0026	0.0002	
+/-[e]	0	0.0003	0.0003	0.0003	0.0022	0.0005	0.0003	
moles Xe (diss+pl)[d]	0.000008	0.000407	0.001353	0.002386	0.008198	0.003794	0.000109	
+/-[d]	0	0.000039	0.000145	0.000301	0.001171	0.000361	0.000109	
Kr+Xe diss&pl (g)[d]	0.0013	0.0635	0.2116	0.3319	1.2697	0.5963	0.0146	
+/-[d]	0.0001	0.0054	0.0198	0.0417	0.1592	0.0496	0.0146	
moles Xe (tot)[o]	8.0000E-06	4.0764E-04	1.3581E-03	2.3953E-03	8.2697E-03	3.8105E-03	1.1049E-04	
+/-[p]	0.0000E+00	3.9047E-05	1.4501E-04	3.0101E-04	1.1712E-03	3.6102E-04	1.0904E-04	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project								
Cs-137 (atoms)[f]	ND	5.2850E+19	2.3070E+20	3.0370E+20	1.0190E+21	5.8020E+20	4.3110E+18	
+/-[f]	NA	1.4450E+17	6.3210E+17	9.7180E+17	2.7180E+18	1.7030E+18	1.4990E+16	
Cs-137 (g)[m]	NA	1.2014E-02	5.2441E-02	6.9035E-02	2.3163E-01	1.3189E-01	9.7995E-04	
+/-[m]	NA	3.2847E-05	1.4369E-04	2.2090E-04	6.1784E-04	3.8712E-04	3.4074E-06	
Total								4.9799E-01
+/-[n]								7.7596E-04
Ce-144 (atoms)[g]	ND	1.8920E+18	1.0290E+19	1.8460E+19	5.2140E+19	4.6790E+19	6.7450E+17	
+/-[g]	NA	1.3420E+16	7.4980E+16	1.3290E+17	3.6860E+17	3.2320E+17	4.7070E+15	
Ce-144 (g)[m]	NA	4.5209E-04	2.4588E-03	4.4110E-03	1.2459E-02	1.1180E-02	1.6117E-04	
+/-[m]	NA	3.2067E-06	1.7916E-05	3.1756E-05	8.8076E-05	7.7228E-05	1.1247E-06	
Total								3.1122E-02
+/-[n]								1.2273E-04

Rod "O" 0201562 (SI-1, 2P39)

	O-00	O-01	O-02	O-03	O-04	O-05	O-06	O-07
seg length (in)[a]	11.527	17.912	17.606	17.409	21.29	21.163	8.917	1.038
total length (in)								1.1686E+02
Zr-95 (atoms)[h]	ND	ND	6.1270E+16	1.4080E+17	4.6280E+17	4.3680E+17	9.1710E+15	
+/-[h]	NA	NA	1.4150E+16	2.2960E+16	9.4580E+16	3.6910E+16	2.5870E+14	
Zr-95 (g)[m]	NA	NA	9.6550E-06	2.2187E-05	7.2928E-05	6.8831E-05	1.4452E-06	
+/-[m]	NA	NA	2.2298E-06	3.6181E-06	1.4904E-05	5.8163E-06	4.0766E-08	
Total								1.7505E-04
+/-[n]								1.6554E-05

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod O, 0201562, page 4
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod O, 0201562, page 7
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod O, 0201562, page 8
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod O, 0201562, page 11
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod O, 0201562, page 12
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod O, 0201562, page 13
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod O, 0201562, page 14
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod O, 0201562, page 15
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "P" 0307602 (SI-1, 3N63)

	P-00	P-01	P-02	P-03	P-04	P-05	P-06	P-07
seg length (in)[a]	10.355	17.587	20.541	21.401	17.671	17.74	9.656	2.045
total length (in)								1.1700E+02
U-232 wt%[b]	0	0.0935	0.2329	0.1619	0.1269	0.0399	0.0227	
+/-[b]	0	0.0029	0.0072	0.005	0.0039	0.0012	0.0007	
U-232 g[j]	0.0000E+00	8.2375E-04	5.0879E-03	7.9195E-03	5.6130E-03	2.0185E-03	4.3078E-05	
+/-[j]	NA	2.5550E-05	1.5730E-04	2.4459E-04	1.7251E-04	6.0709E-05	1.3285E-06	
Segment Total								2.1506E-02
+/-[n]								3.4448E-04
U-233 wt%[b]	100	95.0065	89.4504	80.6674	84.5715	91.6893	98.1934	
+/-[b]	0	0.007	0.0094	0.0073	0.0077	0.0071	0.0202	
U-233 g[j]	4.0000E-05	8.3703E-01	1.9541E+00	3.9459E+00	3.7407E+00	4.6385E+00	1.8634E-01	
+/-[j]	1.0000E-05	1.6404E-04	5.1665E-04	9.3409E-04	9.0388E-04	1.1053E-03	7.0289E-05	
Segment Total								1.5303E+01
+/-[n]								1.7916E-03
U-234 wt%[b]	0	4.4433	8.7916	15.2482	12.4319	6.9345	1.6947	
+/-[b]	0	0.0014	0.0016	0.002	0.0018	0.0015	0.0015	
U-234 g[j]	0.0000E+00	3.9146E-02	1.9206E-01	7.4588E-01	5.4988E-01	3.5081E-01	3.2160E-03	
+/-[j]	NA	1.4236E-05	5.8249E-05	1.9024E-04	1.4658E-04	1.0958E-04	3.0227E-06	
Segment Total								1.8810E+00
+/-[n]								2.7072E-04
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
+/-[b]	0	0.0046	0.0052	0.005	0.0055	0.0052	0.0145	
U-235 g[j]	0.0000E+00	3.7831E-03	3.0897E-02	1.5492E-01	1.0110E-01	4.6568E-02	1.1234E-04	
+/-[j]	NA	4.0533E-05	1.1385E-04	2.4692E-04	2.4432E-04	2.6328E-04	2.7517E-05	
Segment Total								3.3739E-01
+/-[n]								4.5314E-04
U-236 wt%[b]	0	0.0181	0.1051	0.3862	0.2344	0.0792	0.0012	
+/-[b]	0	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	
U-236 g[j]	0.0000E+00	1.5946E-04	2.2960E-03	1.8891E-02	1.0368E-02	4.0067E-03	2.2772E-06	
+/-[j]	NA	1.7623E-06	4.4046E-06	1.0620E-05	9.1456E-06	1.0158E-05	3.7954E-07	
Segment Total								3.5724E-02
+/-[n]								1.7952E-05

Rod "P" 0307602 (SI-1, 3N63)

	P-00	P-01	P-02	P-03	P-04	P-05	P-06	P-07
seg length (in)[a]	10.355	17.587	20.541	21.401	17.671	17.74	9.656	2.045
total length (in)								1.1700E+02
U-238 wt%[b]	0	0.0092	0.0057	0.3691	0.3495	0.3366	0.0287	
+/-[b]	0	0.0047	0.0053	0.0051	0.0056	0.0053	0.0145	
U-238 g[i]	0.0000E+00	8.1054E-05	1.2452E-04	1.8055E-02	1.5459E-02	1.7028E-02	5.4464E-05	
+/-[j]	NA	4.1408E-05	1.1578E-04	2.4950E-04	2.4772E-04	2.6815E-04	2.7517E-05	
Segment Total								5.0802E-02
+/-[n]								4.5978E-04
tot U[c]	0.00029	0.88102	2.1846	4.89162	4.42316	5.05896	0.18977	
+/-[c]	0.00001	0.00016	0.00053	0.00107	0.00099	0.00114	0.00006	
Kr-82 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0	0	0	0	0	0	0	
Kr-82 (g)[k]	3.2765E-07	2.0508E-05	8.2597E-05	2.9454E-04	2.1310E-04	1.2482E-04	6.5531E-06	
+/-[j]	0.0000E+00	3.1140E-06	8.8471E-06	2.8347E-05	2.8998E-05	2.0806E-05	6.5531E-06	
Segment Total								7.4244E-04
+/-[n]								4.6992E-05
Kr-83 (mol%)[d]	15.1	15.1	15.1	15.1	15.1	15.1	15.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-83 (g)[k]	2.5040E-05	1.5673E-03	6.3123E-03	2.2510E-02	1.6285E-02	9.5390E-03	5.0080E-04	
+/-[j]	1.6583E-07	2.3820E-04	6.7741E-04	2.1714E-03	2.2187E-03	1.5913E-03	5.0081E-04	
Segment Total								5.6739E-02
+/-[n]								3.5968E-03
Kr-84 (mol%)[d]	30.5	30.5	30.5	30.5	30.5	30.5	30.5	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-84 (g)[k]	5.1186E-05	3.2037E-03	1.2903E-02	4.6014E-02	3.3290E-02	1.9499E-02	1.0237E-03	
+/-[j]	1.6782E-07	4.8658E-04	1.3827E-03	4.4309E-03	4.5314E-03	3.2510E-03	1.0237E-03	
Segment Total								1.1598E-01
+/-[n]								7.3438E-03

Rod "P" 0307602 (SI-1, 3N63)

	P-00	P-01	P-02	P-03	P-04	P-05	P-06	P-07
seg length (in)[a]	10.355	17.587	20.541	21.401	17.671	17.74	9.656	2.045
total length (in)								1.1700E+02
Kr-85 (mol%)[d]	5.7	5.7	5.7	5.7	5.7	5.7	5.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	9.6800E-06	6.0587E-04	2.4402E-03	8.7018E-03	6.2956E-03	3.6876E-03	1.9360E-04	
+/-[j]	1.6982E-07	9.2610E-05	2.6486E-04	8.5125E-04	8.6380E-04	6.1808E-04	1.9363E-04	
Segment Total								2.1934E-02
+/-[n]								1.4032E-03
Kr-86 (mol%)[d]	48.5	48.5	48.5	48.5	48.5	48.5	48.5	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-86 (g)[k]	8.3333E-05	5.2158E-03	2.1007E-02	7.4912E-02	5.4197E-02	3.1746E-02	1.6667E-03	
+/-[j]	1.7182E-07	7.9206E-04	2.2505E-03	7.2111E-03	7.3761E-03	5.2921E-03	1.6667E-03	
Segment Total								1.8883E-01
+/-[n]								1.1953E-02
Rod Total								3.8423E-01
+/-[n]								1.4551E-02
shear gas (g)[e]	0	0.0001	0.0007	0.0078	0.0036	0.0012	0	
+/-[e]	0	0.0003	0.0003	0.0016	0.0007	0.0003	0.0003	
moles Kr (diss+pl)[d]	0.000002	0.000125	0.000503	0.001785	0.001295	0.00076	0.00004	
+/-[d]	0	0.000019	0.000054	0.000173	0.000177	0.000127	0.00004	
Kr+Xe diss&pl (g)[d]	0.0012	0.0694	0.2999	1.0794	0.8133	0.4813	0.0106	
+/-[d]	0	0.0085	0.0246	0.0787	0.0727	0.0439	0.008	
moles kr (tot)[o]	2.0000E-06	1.2518E-04	5.0417E-04	1.7979E-03	1.3007E-03	7.6189E-04	4.0000E-05	
+/-[p]	0	1.9008E-05	5.4003E-05	1.7303E-04	1.7701E-04	1.2700E-04	4.0000E-05	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	
Xe-128 (g)[k]	1.0232E-06	5.6102E-05	2.4564E-04	8.9033E-04	6.7305E-04	3.9800E-04	6.9068E-06	
+/-[j]	0.0000E+00	8.0616E-06	2.3024E-05	7.3687E-05	6.7793E-05	4.0546E-05	6.9068E-06	
SegmentTotal								2.2711E-03
+/-[n]								1.1096E-04

Rod "P" 0307602 (SI-1, 3N63)

	P-00	P-01	P-02	P-03	P-04	P-05	P-06	P-07
seg length (in)[a]	10.355	17.587	20.541	21.401	17.671	17.74	9.656	2.045
total length (in)								1.1700E+02
Xe-130 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0	0	0	0	0	0	0	
Xe-130 (g)[k]	2.0785E-06	1.1396E-04	4.9895E-04	1.8085E-03	1.3672E-03	8.0845E-04	1.4030E-05	
+/-[j]	0.0000E+00	1.6375E-05	4.6768E-05	1.4968E-04	1.3771E-04	8.2361E-05	1.4030E-05	
SegmentTotal								4.6131E-03
+/-[n]								2.2539E-04
Xe-131 (mol%)[d]	10.8	10.8	10.8	10.8	10.8	10.8	10.8	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	1.1310E-04	6.2013E-03	2.7151E-02	9.8412E-02	7.4396E-02	4.3993E-02	7.6344E-04	
+/-[j]	1.0472E-06	8.9293E-04	2.5573E-03	8.1958E-03	7.5250E-03	4.5002E-03	7.6347E-04	
SegmentTotal								2.5103E-01
+/-[n]								1.2328E-02
Xe-132 (mol%)[d]	23.1	23.1	23.1	23.1	23.1	23.1	23.1	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	2.4376E-04	1.3365E-02	5.8517E-02	2.1210E-01	1.6034E-01	9.4814E-02	1.6454E-03	
+/-[j]	1.0552E-06	1.9213E-03	5.4908E-03	1.7578E-02	1.6165E-02	9.6679E-03	1.6454E-03	
SegmentTotal								5.4102E-01
+/-[n]								2.6463E-02
Xe-134 (mol%)[d]	25.4	25.4	25.4	25.4	25.4	25.4	25.4	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-134 (g)[k]	2.7210E-04	1.4919E-02	6.5319E-02	2.3676E-01	1.7898E-01	1.0584E-01	1.8366E-03	
+/-[j]	2.1425E-06	2.1469E-03	6.1441E-03	1.9683E-02	1.8082E-02	1.0814E-02	1.8367E-03	
SegmentTotal								6.0392E-01
+/-[n]								2.9616E-02

Rod "Q" 0401744 (SI-1, 4M49)

	Q-00	Q-01	Q-02	Q-03	Q-04	Q-05	Q-06	Q-07
seg length (in)[a]	11.29	24.915	17.858	17.655	17.655	17.727	8.822	1.016
total length (in)								1.1694E+02
U-232 wt%[b]	0	0.1456	0.1369	0.1673	0.1306	0.0415	0.0248	
+/-[b]	0	0.0045	0.0042	0.0052	0.004	0.0013	0.0008	
U-232 g[i]	0.0000E+00	2.1672E-03	5.7479E-03	7.0670E-03	5.8779E-03	2.1102E-03	4.5630E-05	
+/-[j]	NA	6.6983E-05	1.7635E-04	2.1966E-04	1.8004E-04	6.6106E-05	1.4721E-06	
Segment Total								2.3016E-02
+/-[n]								3.4731E-04
U-233 wt%[b]	100	93.9175	82.8697	82.2492	85.317	92.1545	98.1308	
+/-[b]	0	0.0078	0.0084	0.0083	0.0075	0.0072	0.0227	
U-233 g[i]	4.0000E-05	1.3979E+00	3.4794E+00	3.4743E+00	3.8399E+00	4.6860E+00	1.8055E-01	
+/-[j]	1.0000E-05	3.8424E-04	1.1100E-03	1.1096E-03	1.1675E-03	1.4211E-03	8.8923E-05	
Segment Total								1.7058E+01
+/-[n]								2.4498E-03
U-234 wt%[b]	0	5.294	13.6937	14.1381	11.8792	6.591	1.7662	
+/-[b]	0	0.001	0.0019	0.0019	0.0015	0.001	0.0011	
U-234 g[i]	0.0000E+00	7.8799E-02	5.7495E-01	5.9721E-01	5.3465E-01	3.3515E-01	3.2496E-03	
+/-[j]	NA	2.5453E-05	1.9133E-04	1.9797E-04	1.6963E-04	1.1059E-04	2.4683E-06	
Segment Total								2.1240E+00
+/-[n]								3.4272E-04
U-[illegible] wt%[b]	0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	0.0605	
+/-[b]	0	0.005	0.0064	0.0059	0.0055	0.0055	0.0164	
U-235 g[i]	0.0000E+00	9.0557E-03	1.1032E-01	1.1674E-01	9.4821E-02	4.0150E-02	1.1131E-04	
+/-[j]	NA	7.4460E-05	2.7078E-04	2.5172E-04	2.4907E-04	2.7992E-04	3.0174E-05	
Segment Total								3.7119E-01
+/-[n]								5.3247E-04
U-236 wt%[b]	0	0.0301	0.2464	0.2738	0.172	0.0375	0.0012	
+/-[b]	0	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
U-236 g[i]	0.0000E+00	4.4802E-04	1.0345E-02	1.1566E-02	7.7412E-03	1.9068E-03	2.2079E-06	
+/-[j]	NA	1.4931E-06	5.2365E-06	5.4887E-06	5.0332E-06	5.1155E-06	1.8399E-07	
Segment Total								3.2009E-02
+/-[n]								1.0550E-05

Rod "Q" 0401744 (SI-1, 4M49)

	Q-00	Q-01	Q-02	Q-03	Q-04	Q-05	Q-06	Q-07
seg length (in)[a]	11.29	24.915	17.858	17.655	17.655	17.727	8.822	1.016
total length (in)								1.1694E+02
U-238 wt%[b]	0	0.0044	0.4258	0.408	0.3944	0.3858	0.0166	
+/-[b]	0	0.0048	0.0063	0.0059	0.0053	0.0053	0.0162	
U-238 g[i]	0.0000E+00	6.5492E-05	1.7878E-02	1.7234E-02	1.7751E-02	1.9618E-02	3.0542E-05	
+/-[j]	NA	7.1446E-05	2.6457E-04	2.4928E-04	2.3859E-04	2.6956E-04	2.9806E-05	
Segment Total								7.2576E-02
+/-[n]								5.1742E-04
tot U[c]	0.00008	1.48845	4.19863	4.22412	4.50069	5.08489	0.18399	
+/-[c]	0.00001	0.00039	0.00127	0.00128	0.00131	0.00149	0.00008	
Kr-82 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0	0	0	0	0	0	0	
Kr-82 (g)[k]	1.3106E-06	2.9873E-05	2.3273E-04	2.5732E-04	1.9262E-04	1.1320E-04	0.0000E+00	
+/-[j]	0.0000E+00	4.9156E-06	1.2291E-05	3.0639E-05	3.0309E-05	2.0479E-05	NA	
Segment Total								8.2705E-04
+/-[n]								4.9518E-05
Kr-83 (mol%)[d]	15.2	15.2	15.2	15.2	15.2	15.2	15.2	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-83 (g)[k]	1.0082E-04	2.2981E-03	1.7904E-02	1.9795E-02	1.4818E-02	8.7082E-03	0.0000E+00	
+/-[j]	1.3266E-06	3.7935E-04	9.7443E-04	2.3714E-03	2.3398E-03	1.5796E-03	NA	
Segment Total								6.3624E-02
+/-[n]								3.8323E-03
Kr-84 (mol%)[d]	30.6	30.6	30.6	30.6	30.6	30.6	30.6	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-84 (g)[k]	2.0542E-04	4.6821E-03	3.6476E-02	4.0330E-02	3.0190E-02	1.7742E-02	0.0000E+00	
+/-[j]	1.3426E-06	7.7103E-04	1.9411E-03	4.8094E-03	4.7545E-03	3.2118E-03	NA	
Segment Total								1.2963E-01
+/-[n]								7.7726E-03

Rod "Q" 0401744 (SI-1, 4M49)

	Q-00	Q-01	Q-02	Q-03	Q-04	Q-05	Q-06	Q-07
seg length (in)[a]	11.29	24.915	17.858	17.655	17.655	17.727	8.822	1.016
total length (in)								1.1694E+02
Kr-85 (mol%)[d]	5.7	5.7	5.7	5.7	5.7	5.7	5.7	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Kr-85 (g)[k]	3.8720E-05	8.8255E-04	6.8756E-03	7.6021E-03	5.6906E-03	3.3443E-03	0.0000E+00	
+/-[j]	6.7930E-07	1.4605E-04	3.8263E-04	9.1496E-04	9.0099E-04	6.0785E-04	NA	
Segment Total								2.4434E-02
+/-[n]								1.4786E-03
Kr-86 (mol%)[d]	48.3	48.3	48.3	48.3	48.3	48.3	48.3	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Kr-86 (g)[k]	3.3196E-04	7.5664E-03	5.8947E-02	6.5175E-02	4.8788E-02	2.8672E-02	0.0000E+00	
+/-[j]	1.3746E-06	1.2454E-03	3.1227E-03	7.7651E-03	7.6796E-03	5.1883E-03	NA	
Segment Total								2.0948E-01
+/-[n]								1.2550E-02
Rod Total								4.2799E-01
+/-[n]								1.5323E-02
shear gas (g)[a]	0	0.0002	0.0053	[illegible]	[illegible]	0.0012	0	
+/-[e]	0	0.0003	0.0011	0.0014	0.0008	0.0003	0.0003	
moles Kr (diss+pl)[d]	0.000008	0.000182	0.001412	0.001559	0.001169	0.000689	0	
+/-[d]	0	0.00003	0.000075	0.000187	0.000185	0.000125	0	
Kr+Xe diss&pl (g)[d]	0.0046	0.1053	0.8716	0.961	0.7272	0.42	0	
+/-[d]	0.0002	0.0165	0.0462	0.0852	0.068	0.0353	0	
moles kr (tot)[o]	8.0000E-06	1.8235E-04	1.4206E-03	1.5707E-03	1.1758E-03	6.9097E-04	0	
+/-[p]	0.0000E+00	3.0005E-05	7.5024E-05	1.8702E-04	1.8501E-04	1.2500E-04	0	
Xe-128 (mol%)[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
+/-[d]	0	0	0	0	0	0	0	
Xe-128 (g)[k]	3.8371E-06	8.5730E-05	7.2062E-04	7.9546E-04	6.0179E-04	3.4543E-04	0.0000E+00	
+/-[j]	1.2790E-07	1.5606E-05	3.8000E-05	7.9696E-05	6.2934E-05	3.1977E-05	NA	
SegmentTotal								2.5529E-03
+/-[n]								1.1411E-04

Rod "Q" 0401744 (SI-1, 4M49)

	Q-00	Q-01	Q-02	Q-03	Q-04	Q-05	Q-06	Q-07
seg length (in)[a]	11.29	24.915	17.858	17.655	17.655	17.727	8.822	1.016
total length (in)								1.1694E+02
Xe-130 (mol%)[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
+/-[d]	0	0	0	0	0	0	0	
Xe-130 (g)[k]	7.7942E-06	1.7414E-04	1.4638E-03	1.6158E-03	1.2224E-03	7.0166E-04	0.0000E+00	
+/-[j]	2.5981E-07	3.1700E-05	7.7187E-05	1.6188E-04	1.2784E-04	6.4954E-05	NA	
SegmentTotal								5.1856E-03
+/-[n]								2.3180E-04
Xe-131 (mol%)[d]	10.9	10.9	10.9	10.9	10.9	10.9	10.9	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-131 (g)[k]	4.2806E-04	9.5639E-03	8.0390E-02	8.8740E-02	6.7134E-02	3.8535E-02	0.0000E+00	
+/-[j]	1.4799E-05	1.7432E-03	4.3028E-03	8.9279E-03	7.0477E-03	3.5848E-03	NA	
SegmentTotal								2.8479E-01
+/-[n]								1.2798E-02
Xe-132 (mol%)[d]	23.3	23.3	23.3	23.3	23.3	23.3	23.3	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-132 (g)[k]	9.2201E-04	2.0600E-02	1.7316E-01	1.9114E-01	1.4460E-01	8.3002E-02	0.0000E+00	
+/-[j]	3.0987E-05	3.7510E-03	9.1610E-03	1.9168E-02	1.5135E-02	7.6920E-03	NA	
SegmentTotal								6.1342E-01
+/-[n]								2.7452E-02
Xe-134 (mol%)[d]	25.4	25.4	25.4	25.4	25.4	25.4	25.4	
+/-[d]	0.1	0.1	0.1	0.1	0.1	0.1	0.1	
Xe-134 (g)[k]	1.0204E-03	2.2797E-02	1.9163E-01	2.1153E-01	1.6003E-01	9.1856E-02	0.0000E+00	
+/-[j]	3.4248E-05	4.1510E-03	1.0133E-02	2.1209E-02	1.6747E-02	8.5110E-03	NA	
SegmentTotal								6.7885E-01
+/-[n]								3.0375E-02

Rod "Q" 0401744 (SI-1, 4M49)

	Q-00	Q-01	Q-02	Q-03	Q-04	Q-05	Q-06	Q-07
seg length (in)[a]	11.29	24.915	17.858	17.655	17.655	17.727	8.822	1.016
total length (in)								1.1694E+02
Xe-136 (mol%)[d]	40.2	40.2	40.2	40.2	40.2	40.2	40.2	
+/-[d]	0.2	0.2	0.2	0.2	0.2	0.2	0.2	
Xe-136 (g)[k]	1.6390E-03	3.6620E-02	3.0781E-01	3.3979E-01	2.5706E-01	1.4755E-01	0.0000E+00	
+/-[j]	5.5240E-05	6.6688E-03	1.6304E-02	3.4085E-02	2.6913E-02	1.3679E-02	NA	
SegmentTotal								1.0905E+00
+/-[n]								4.8821E-02
Rod total								2.6753E+00
+/-[n]								6.4989E-02
shear gas (g)[e]	0	0.0002	0.0053	0.0072	0.0042	0.0012	0	
+/-[e]	0	0.0003	0.0011	0.0014	0.0008	0.0003	0.0003	
moles Xe (diss+pl)[d]	0.00003	0.000669	0.0056	0.006173	0.004678	0.002693	0	
+/-[d]	0.000001	0.000122	0.000297	0.000623	0.000492	0.00025	0	
Kr+Xe diss&pl (g)[d]	0.0046	0.1053	0.8716	0.961	0.7272	0.42	0	
+/-[d]	0.0002	0.0165	0.0462	0.0852	0.068	0.0353	0	
moles Xe (tot)[o]	3.0000E-05	6.7027E-04	5.6341E-03	6.2192E-03	4.7050E-03	2.7007E-03	0	
+/-[p]	1.0000E-06	1.2202E-04	2.9710E-04	6.2310E-04	4.9204E-04	2.5001E-04	0	
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project								
Cs-137 (atoms)[f]	ND	9.0070E+19	7.6440E+20	8.0030E+20	6.8580E+20	3.7140E+20	3.7300E+18	
+/-[f]	NA	2.3610E+17	2.0670E+18	2.1670E+18	1.8530E+18	1.1050E+18	1.2820E+16	
Cs-137 (g)[m]	NA	2.0474E-02	1.7376E-01	1.8192E-01	1.5589E-01	8.4424E-02	8.4788E-04	
+/-[m]	NA	5.3669E-05	4.6986E-04	4.9259E-04	4.2121E-04	2.5118E-04	2.9142E-06	
Total								6.1732E-01
+/-[n]								8.4072E-04
Ce-144 (atoms)[g]	ND	3.4940E+18	2.4120E+19	3.4990E+19	3.9930E+19	3.2300E+19	5.8480E+17	
+/-[g]	NA	2.2970E+16	1.6830E+17	2.5880E+17	2.7060E+17	2.1900E+17	3.9860E+15	
Ce-144 (g)[m]	NA	8.3488E-04	5.7634E-03	8.3608E-03	9.5412E-03	7.7180E-03	1.3974E-04	
+/-[m]	NA	5.4886E-06	4.0215E-05	6.1840E-05	6.4659E-05	5.2330E-05	9.5245E-07	
Total								3.2358E-02
+/-[n]								1.1132E-04

Rod "Q" 0401744 (SI-1, 4M49)

	Q-00	Q-01	Q-02	Q-03	Q-04	Q-05	Q-06	Q-07
seg length (in)[a]	11.29	24.915	17.858	17.655	17.655	17.727	8.822	1.016
total length (in)								1.1694E+02
Zr-95 (atoms)[h]	ND	ND	1.6040E+17	2.1710E+17	2.8820E+17	3.4550E+17	8.3010E+15	
+/-[h]	NA	NA	4.6110E+16	6.2070E+16	6.6950E+16	3.4900E+16	7.2790E+14	
Zr-95 (g)[m]	NA	NA	2.5276E-05	3.4211E-05	4.5415E-05	5.4444E-05	1.3081E-06	
+/-[m]	NA	NA	7.2661E-06	9.7811E-06	1.0550E-05	5.4996E-06	1.1470E-07	
Total								1.6065E-04
+/-[n]								1.7030E-05

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod Q, 0401744, page 3
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod Q, 0401744, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod Q, 0401744 , page 7
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod Q, 0401744, page 10
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod Q, 0401744, page 11
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod Q, 0401744, page 12
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod Q, 0401744, page 13
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod Q, 0401744, page 14
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $((((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2} (xy/z))^2 + (sd_y)^2)^{1/2}$, where sd is the +/- in the table

Rod "R" 3110505 (RIV-3 E3)

	R-00	R-01	R-02	R-03	R-04	R-05	R-06	R-07	R-08	R-09	R-10	R-11	R-12	R-13	R-14	R-15	R-16
seg length (in)[a]	6.181	3.278	7.001	6.996	7.004	7	7	6.998	6.986	7.015	6.979	7.02	7.003	6.998	6.999	7.024	3.727
total length (in)																	1.1121E+02
U-232 wt%[b]	0	0.0019	0.0082	0.0212	0.0361	0.0522	0.0642	0.0721	0.0763	0.074	0.0707	0.0606	0.0463	0.0295	0.0138	0.0035	
+/-[b]	0	0.0001	0.0003	0.0007	0.0011	0.0016	0.002	0.0022	0.0024	0.0023	0.0022	0.0019	0.0014	0.0009	0.0004	0.0001	
U-232 g[f]	0.0000E+00	9.6919E-07	3.1067E-05	2.0065E-04	5.4060E-04	1.0930E-03	1.5802E-03	1.8943E-03	2.1156E-03	1.9808E-03	1.8423E-03	1.4205E-03	8.5330E-04	3.7978E-04	8.9677E-05	6.3413E-06	
+/-[f]	NA	5.1027E-08	1.1366E-06	6.6255E-06	1.6473E-05	3.3504E-05	4.9229E-05	5.7803E-05	6.6546E-05	6.1567E-05	5.7330E-05	4.4537E-05	2.5802E-05	1.1587E-05	2.5994E-06	1.8120E-07	
Segment Total																	1.4029E-02
+/-[e]																	1.4663E-04
U-233 wt%[b]	100	99.7066	99.4487	98.7621	98.0395	97.1846	96.59	96.3164	96.0604	96.2585	96.3287	96.7773	97.5244	98.2966	99.1253	99.6717	
+/-[b]	0	0.124	0.0168	0.0085	0.008	0.0075	0.0074	0.0079	0.0091	0.0082	0.0075	0.0085	0.0079	0.0094	0.01	0.0349	
U-233 g[f]	4.0000E-05	5.0860E-02	3.7678E-01	9.3476E-01	1.4682E+00	2.0350E+00	2.3775E+00	2.5306E+00	2.6635E+00	2.5766E+00	2.5102E+00	2.2685E+00	1.7973E+00	1.2655E+00	6.4415E-01	1.8059E-01	
+/-[f]	1.0000E-05	9.4192E-05	1.0983E-04	2.2246E-04	3.6345E-04	5.2920E-04	5.2520E-04	5.6895E-04	6.4682E-04	5.9990E-04	5.6471E-04	5.3226E-04	4.6238E-04	3.1875E-04	1.5324E-04	1.0177E-04	
Segment Total																	2.3680E+01
+/-[e]																	1.6769E-03
U-234 wt%[b]	0	0.1424	0.505	1.1737	1.8414	2.6077	3.1227	3.3492	3.5739	3.4003	3.347	2.9629	2.2988	1.6071	0.8267	0.2538	
+/-[b]	0	0.003	0.0003	0.0003	0.0003	0.0004	0.0004	0.0004	0.0005	0.0004	0.0004	0.0004	0.0003	0.0003	0.0003	0.0003	
U-234 g[f]	0.0000E+00	7.2638E-05	1.9133E-03	1.1109E-02	2.7575E-02	5.4603E-02	7.6862E-02	8.7995E-02	9.9094E-02	9.1018E-02	8.7218E-02	6.9450E-02	4.2366E-02	2.0690E-02	5.3721E-03	4.5993E-04	
+/-[f]	NA	1.5335E-06	1.2241E-06	3.7600E-06	7.8562E-06	1.5938E-05	1.8723E-05	2.1208E-05	2.6138E-05	2.2441E-05	2.1155E-05	1.7783E-05	1.1729E-05	6.1775E-06	2.2672E-06	5.8022E-07	
Segment Total																	6.7580E-01
+/-[e]																	5.7147E-05
U-235 wt%[b]	0	0.0029	0.0067	0.0311	0.0751	0.1482	0.2135	0.2521	0.2784	0.2564	0.2431	0.1901	0.1228	0.0569	0.0169	0.014	
+/-[b]	0	0.0882	0.012	0.0062	0.0058	0.0055	0.0053	0.0056	0.0066	0.0059	0.0054	0.0061	0.0057	0.0068	0.0072	0.0249	
U-235 g[f]	0.0000E+00	1.4793E-06	2.5384E-05	2.9436E-04	1.1246E-03	3.1032E-03	5.2551E-03	6.6235E-03	7.7192E-03	6.8632E-03	6.3348E-03	4.4559E-03	2.2632E-03	7.3252E-04	1.0982E-04	2.5365E-05	
+/-[f]	NA	4.4991E-05	4.5464E-05	5.8682E-05	8.6856E-05	1.1517E-04	1.3046E-04	1.4714E-04	1.8301E-04	1.5794E-04	1.4072E-04	1.4299E-04	1.0505E-04	8.7543E-05	4.6788E-05	4.5114E-05	
Segment Total																	4.4932E-02
+/-[e]																	4.3430E-04
U-236 wt%[b]	0	0.0001	0.0002	0.0003	0.001	0.0025	0.0047	0.0058	0.0071	0.0064	0.0059	0.004	0.0019	0.0008	0.0001	0.0002	
+/-[b]	0	0.0002	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	
U-236 g[f]	0.0000E+00	5.1010E-08	7.5774E-07	2.8394E-06	1.4975E-05	5.2348E-05	1.1569E-04	1.5239E-04	1.9686E-04	1.7131E-04	1.5375E-04	9.3760E-05	3.5016E-05	1.0299E-05	6.4983E-07	3.6236E-07	
+/-[f]	NA	1.0202E-07	3.7887E-07	9.4648E-07	1.4975E-06	2.0940E-06	2.4615E-06	2.6275E-06	2.7730E-06	2.6770E-06	2.6061E-06	2.3441E-06	1.8430E-06	1.2874E-06	6.4983E-07	1.8118E-07	
Segment Total																	1.0011E-03
+/-[e]																	7.3001E-06
U-238 wt%[b]	0	0.1462	0.0312	0.0116	0.0069	0.0048	0.0048	0.0044	0.0039	0.0045	0.0046	0.005	0.0058	0.0091	0.0172	0.0569	
+/-[b]	0	0.0875	0.0118	0.006	0.0056	0.0053	0.0051	0.0054	0.0064	0.0057	0.0052	0.006	0.0055	0.0066	0.007	0.0247	
U-238 g[f]	0.0000E+00	7.4577E-05	1.1821E-04	1.0979E-04	1.0333E-04	1.0051E-04	1.1815E-04	1.1560E-04	1.0814E-04	1.2045E-04	1.1987E-04	1.1720E-04	1.0689E-04	1.1715E-04	1.1177E-04	1.0309E-04	
+/-[f]	NA	4.4634E-05	4.4707E-05	5.6789E-05	8.3861E-05	1.1098E-04	1.2553E-04	1.4188E-04	1.7745E-04	1.5257E-04	1.3550E-04	1.4064E-04	1.0136E-04	8.4968E-05	4.5488E-05	4.4751E-05	
Segment Total																	1.6447E-03
+/-[e]																	4.2063E-04
tot U[c]	0.00003	0.05101	0.37887	0.94648	1.49751	2.09391	2.46141	2.62735	2.7727	2.67675	2.60586	2.34399	1.84297	1.28739	0.64983	0.18118	
+/-[c]	0.00001	0.00007	0.00009	0.00021	0.00035	0.00052	0.00051	0.00055	0.00062	0.00058	0.00055	0.00051	0.00045	0.0003	0.00014	0.00008	

Rod "R" 3110505 (RIV-3 E3)

	R-00	R-01	R-02	R-03	R-04	R-05	R-06	R-07	R-08	R-09	R-10	R-11	R-12	R-13	R-14	R-15	R-16
seg length (in)[a]	6.181	3.278	7.001	6.996	7.004	7	7	6.998	6.986	7.015	6.979	7.02	7.003	6.998	6.999	7.024	3.727
total length (in)																	1.1121E+02
Kr-82 (mol%)[d]																	
+/-[d]																	
Kr-82 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[l]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total																	0.0000E+00
+/-[t]																	NA
Kr-83 (mol%)[d]																	
+/-[d]																	
Kr-83 (g)[k]	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
+/-[l]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total																	0.0000E+00
+/-[t]																	NA
Kr-84 (mol%)[d]																	
+/-[d]																	
Kr-84 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[l]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total																	0.0000E+00
+/-[t]																	NA
Kr-85 (mol%)[d]																	
+/-[d]																	
Kr-85 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[l]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total																	0.0000E+00
+/-[t]																	NA
Kr-86 (mol%)[d]																	
+/-[d]																	
Kr-86 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[l]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total																	0.0000E+00
+/-[t]																	NA
Rod Total																	0.000E+00
+/-[t]																	NA
shear gas (g)[e]																	
+/-[e]																	
moles Kr (diss+pl)[d]																	
+/-[d]																	
Kr+Xe diss&pl (g)[d]																	
+/-[d]																	
moles Kr (tot)[o]																	
+/-[p]																	

Rod "R" 3110505 (RIV-3 E3)

	R-00	R-01	R-02	R-03	R-04	R-05	R-06	R-07	R-08	R-09	R-10	R-11	R-12	R-13	R-14	R-15	R-16
seg length (in)[a]	8.181	3.278	7.001	6.996	7.004	7	7	6.999	6.986	7.015	6.979	7.02	7.003	6.998	6.999	7.024	3.737
total length (in)																	1.1121E+02
Kr-82 (mol%)[d]																	
+/-[d]																	
Kr-82 (g)[j]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[j]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total																	0.0000E+00
+/-[k]																	NA
Kr-83 (mol%)[d]																	
+/-[d]																	
Kr-83 (g)[j]	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	
+/-[j]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total																	0.0000E+00
+/-[k]																	NA
Kr-84 (mol%)[d]																	
+/-[d]																	
Kr-84 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[j]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total																	0.0000E+00
+/-[k]																	NA
Kr-85 (mol%)[d]																	
+/-[d]																	
Kr-85 (g)[k]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[j]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total																	0.0000E+00
+/-[k]																	NA
Kr-86 (mol%)[d]																	
+/-[d]																	
Kr-86 (g)[j]	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	0.0000E+00	
+/-[j]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
Segment Total																	0.0000E+00
+/-[k]																	NA
Rod Total																	0.000E+00
+/-[k]																	NA
shear gas (g)[c]																	
+/-[e]																	
moles Kr (diss+pl)[d]																	
+/-[d]																	
Kr+Xe diss&pl (g)[d]																	
+/-[d]																	
moles kr (tot)[e]																	
+/-[e]																	

Rod "R" 3110505 (RIV-3 E3)

	R-00	R-01	R-02	R-03	R-04	R-05	R-06	R-07	R-08	R-09	R-10	R-11	R-12	R-13	R-14	R-15	R-16
seg length (in)[a]	6.181	3.278	7.001	6.996	7.004	7	7	6.998	6.986	7.015	6.979	7.02	7.003	6.998	6.999	7.024	3.727
total length (in)																	1.1121E+02
Values corrected to 1/1/84 (page 181, Final Report for the LWBR Proof of Breeding Analytical Support Project																	
Cs-137 (atoms)[f]	ND	1.3540E+17	2.6310E+18	1.3750E+19	3.2750E+19	6.4150E+19	8.9490E+19	1.0160E+20	1.1500E+20	1.0510E+20	1.0180E+20	8.0930E+19	4.9090E+19	2.4700E+19	6.8360E+18	7.0730E+17	
+/-[f]	NA	5.0590E+14	7.3040E+15	3.8140E+16	9.0500E+16	1.6950E+17	2.4900E+17	2.8250E+17	3.1980E+17	2.7740E+17	2.8320E+17	2.2580E+17	1.3650E+17	6.1580E+16	1.7020E+16	1.7640E+15	
Cs-137 (g)[m]	NA	3.0778E-05	5.9806E-04	3.1256E-03	7.4445E-03	1.4582E-02	2.0342E-02	2.3095E-02	2.6141E-02	2.3891E-02	2.3141E-02	1.8397E-02	1.1159E-02	5.6147E-03	1.5539E-03	1.6078E-04	
+/-[m]	NA	1.1500E-07	1.6603E-06	8.6698E-06	2.0572E-05	3.8530E-05	5.6601E-05	6.4216E-05	7.2695E-05	6.3057E-05	6.4375E-05	5.1328E-05	3.1028E-05	1.3998E-05	3.8689E-06	4.0098E-07	
Total																	1.7928E-01
+/-[j]																	1.6287E-04
Ce-144 (atoms)[g]	ND	1.7900E+16	3.1740E+17	1.4680E+18	3.1380E+18	5.5920E+18	7.3100E+18	8.1310E+18	9.1680E+18	8.3640E+16	7.7760E+18	5.8990E+18	3.3750E+18	1.5770E+18	4.1780E+17	4.0870E+16	
+/-[g]	NA	1.9640E+14	2.4250E+15	1.1220E+16	2.3520E+16	4.1910E+16	5.6940E+16	6.3340E+16	6.8700E+16	6.3920E+16	5.9440E+16	4.5960E+16	2.6290E+16	1.2280E+16	3.2530E+15	3.1830E+14	
Ce-144 (g)[m]	NA	4.2772E-06	7.5842E-05	3.5078E-04	7.4982E-04	1.3362E-03	1.7467E-03	1.9429E-03	2.1907E-03	1.9986E-03	1.8581E-03	1.4096E-03	8.0645E-04	3.7682E-04	9.9832E-05	9.7658E-06	
+/-[m]	NA	4.6929E-08	5.7945E-07	2.6810E-06	5.6201E-06	1.0014E-05	1.3606E-05	1.5135E-05	1.6416E-05	1.5274E-05	1.4203E-05	1.0982E-05	6.2819E-06	2.9343E-06	7.7730E-07	7.6057E-08	
Total																	1.4956E-02
+/-[j]																	3.7780E-05
Zr-95 (atoms)[h]	ND	ND	4.3710E+15	1.6040E+16	2.9090E+16	5.8980E+16	7.5130E+16	8.7750E+16	9.0530E+16	7.1950E+16	4.7500E+16	4.7420E+16	2.1220E+16	ND	2.1000E+15	8.8190E+14	
+/-[h]	NA	NA	4.3500E+14	1.0600E+15	3.1900E+15	5.3760E+15	6.0600E+15	7.4730E+15	9.8490E+15	8.1450E+15	7.0460E+15	6.7800E+15	3.2150E+15	NA	5.8250E+14	2.2090E+14	
Zr-95 (g)[m]	NA	NA	6.8879E-07	2.5276E-06	4.5840E-06	9.2941E-06	1.1839E-05	1.3828E-05	1.4266E-05	1.1338E-05	7.4851E-06	7.4725E-06	3.3439E-06	NA	3.3092E-07	1.3897E-07	
+/-[m]	NA	NA	6.8548E-08	1.6704E-07	5.0268E-07	8.4716E-07	9.5494E-07	1.1776E-06	1.5520E-06	1.2835E-06	1.1103E-06	1.0684E-06	5.0662E-07	NA	9.1791E-08	3.4810E-08	
Total																	8.7136E-05
+/-[j]																	3.1620E-06

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod R, 3110505, page 4
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod R, 3110505, page 7
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod R, 3110505, page 8
d. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod R, 3110505, page 11
e. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod R, 3110505, page 12
f. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod R, 3110505, page 13
g. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod R, 3110505, page 14
h. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod R, 3110505, page 15
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
k. (mole%)(number moles gas recovered)(molec wt) / 100
m. (number of atoms per segment)(atomic weight) / 6.0228E+23
n. Error Propagation = $(SUM(sd^2))^{1/2}$, where sd is the +/- in the table
o. ((shear gas / Xe + Kr (diss&pl))(moles Xe or Kr (diss + pl)) + moles Xe or Kr (diss + pl)
p. Error Propagation = $(((sd_x/x)^2 + (sd_y/y)^2 + (sd_z/z)^2)^{1/2}(xy/z))^2 + (sd_t)^2)^{1/2}$ where sd is the +/- in the table

Rod "W" 2514716 Calibration

	W-00	W-01	W-02	W-03	W-04	W-05
seg length (in)[a]	3.7	17.4[illegible]8	17.501	17.498	17.504	6.846
total length (in)						8.0547E+01
U-232 wt%[b]		0.000[illegible]3	0.00061	0.00058	0.00074	
+/-[b]		0.000[illegible]2	0.00002	0.00002	0.00002	
U-232 g[i]		2.3396E[illegible]5	1.0216E-05	9.7224E-06	2.3689E-05	
+/-[j]		6.4100E[illegible]7	3.3500E-07	3.3527E-07	6.4026E-07	
Segment Total						6.7022E-05
+/-[n]						1.0225E-06
U-233 wt%[b]		98.33[illegible]6	97.7203	97.7221	98.3[illegible]31	
+/-[b]		0.00[illegible]1	0.0274	0.0094	0.0063	
U-233 g[i]		3.1515E+[illegible]0	1.6365E+00	1.6381E+00	3.1478E+00	
+/-[j]		8.4883E-[illegible]4	1.1419E-03	4.6713E-04	8.5026E-04	
Segment Total						9.5739E+00
+/-[n]						1.7221E-03
U-234 wt%[b]		1.30[illegible]	1.1589	1.1576	1.[illegible]07	
+/-[b]		0.00[illegible]	0.0005	0.0002	0.0002	
U-234 g[i]		4.1865E-[illegible]2	1.9408E-02	1.9405E-02	4.1839E-02	
+/-[j]		1.2708E-[illegible]5	1.4963E-05	6.1948E-06	1.2709E-05	
Segment Total						1.2252E-01
+/-[n]						2.4192E-05
U-235 wt%[b]		0.07[illegible]	0.0852	0.0846	0.0763	
+/-[b]		0.00[illegible]	0.0198	0.0068	0.0045	
U-235 g[i]		2.4389E-[illegible]	1.4268E-03	1.4181E-03	2.4425E-03	
+/-[j]		1.4102E-[illegible]	3.3159E-04	1.1399E-04	1.4405E-04	
Segment Total						7.7264E-03
+/-[n]						4.0445E-04
U-236 wt%[b]		0.01[illegible]	0.0126	0.0127	0.0192	
+/-[b]		0.000[illegible]	0.0001	0.0001	0.0001	
U-236 g[i]		6.0893E-04	2.1101E-04	2.1289E-04	6.1462E-04	
+/-[j]		3.2088E-06	1.6801E-06	1.6773E-06	3.2052E-06	
Segment Total						1.6474E-03
+/-[n]						5.1192E-06

Rod "W" 2514716 Calibration

	W-00	W-01	W-02	W-03	W-04	W-05
seg length (in)[a]	3.7	17.498	17.501	17.498	17.504	6.846
total length (in)						8.0547E+01
U-238 wt%[b]		0.2633	1.0224	1.0224	0.2636	
+/-[b]		0.0044	0.0197	0.0067	0.0045	
U-238 g[i]		8.4384E-03	1.7122E-02	1.7138E-02	8.4382E-03	
+/-[j]		1.4103E-04	3.3010E-04	1.1240E-04	1.4407E-04	
Segment Total						5.1137E-02
+/-[n]						4.0280E-04
tot U[c,q]		3.20487	1.6747	1.67628	3.20115	
+/-[c,q]		0.00084	0.00107	0.00045	0.00084	

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod W, 2514716, page 4
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod W, 2514716, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod W, 2514716, page 7
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
q. Uranium values corrected for shear loss

Rod "W" 2514716 Calibration

	W-00	W-01	W-02	W-03	W-04	W-05
seg length (in)[a]	3.7	17.498	17.501	17.498	17.504	6.846
total length (in)						8.0547E+01
U-232 wt%[b]		0.000[illegible]3	0.00061	0.00058	0.00074	
+/-[b]		0.000[illegible]2	0.00002	0.00002	0.00002	
U-232 g[i]		2.3396E-05	1.0216E-05	9.7224E-06	2.3689E-05	
+/-[j]		6.4100E-07	3.3500E-07	3.3527E-07	6.4026E-07	
Segment Total						6.7022E-05
+/-[n]						1.0225E-06
U-233 wt%[b]		98.33[illegible]6	97.7203	97.7221	98.3[illegible]31	
+/-[b]		0.00[illegible]1	0.0274	0.0094	0.0063	
U-233 g[i]		3.1515E+00	1.6365E+00	1.6381E+00	3.1478E+00	
+/-[j]		8.4883E-04	1.1419E-03	4.6713E-04	8.5026E-04	
Segment Total						9.5739E+00
+/-[n]						1.7221E-03
U-234 wt%[b]		1.30[illegible]3	1.1589	1.1576	1.[illegible]07	
+/-[b]		0.00[illegible]2	0.0005	0.0002	0.0002	
U-234 g[i]		4.1865E-02	1.9408E-02	1.9405E-02	4.1839E-02	
+/-[j]		1.2708E-05	1.4963E-05	6.1948E-06	1.2709E-05	
Segment Total						1.2252E-01
+/-[n]						2.4192E-05
U-235 wt%[b]		0.07[illegible]	0.0852	0.0846	0.0763	
+/-[b]		0.00[illegible]	0.0198	0.0068	0.0045	
U-235 g[i]		2.4389E-03	1.4268E-03	1.4181E-03	2.4425E-03	
+/-[j]		1.4102E-04	3.3159E-04	1.1399E-04	1.4405E-04	
Segment Total						7.7264E-03
+/-[n]						4.0445E-04
U-236 wt%[b]		0.019	0.0126	0.0127	0.0192	
+/-[b]		0.000[illegible]	0.0001	0.0001	0.0001	
U-236 g[i]		6.0893E-04	2.1101E-04	2.1289E-04	6.1462E-04	
+/-[j]		3.2088E-06	1.6801E-06	1.6773E-06	3.2052E-06	
Segment Total						1.6474E-03
+/-[n]						5.1192E-06

Rod "W" 2514716 Calibration

	W-00	W-01	W-02	W-03	W-04	W-05
seg length (in)[a]	3.7	17.498	17.501	17.498	17.504	6.846
total length (in)						8.0547E+01
U-238 wt%[b]		0.2633	1.0224	1.0224	0.2636	
+/-[b]		0.0044	0.0197	0.0067	0.0045	
U-238 g[i]		8.4384E-03	1.7122E-02	1.7138E-02	8.4382E-03	
+/-[j]		1.4103E-04	3.3010E-04	1.1240E-04	1.4407E-04	
Segment Total						5.1137E-02
+/-[n]						4.0280E-04
tot U[c,q]		3.20487	1.6747	1.67628	3.20115	
+/-[c,q]		0.00084	0.00107	0.00045	0.00084	

Footnotes

a. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod W, 2514716, page 4
b. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod W, 2514716, page 6
c. ANL Destructive Chemical Assay of 33-Rod LWBR EOL Sample - Rod W, 2514716, page 7
i. (abundance of the specified isotope)(total weight of uranium) / 100
j. Error Propagation = $((sd_x/x)^2+(sd_y/y)^2)^{1/2}(xy)$, where sd is the +/- in the table
n. Error Propagation = $(SUM(sd_i^2))^{1/2}$, where sd is the +/- in the table
q. Uranium values corrected for shear loss

Appendix C

Scrap Storage Liner

ABSTRACT

This appendix provides information about the test fuel contained in the scrap can, or Type D storage liner, in dry storage at the Idaho Nuclear Technology and Engineering Center (INTEC). The test fuel has been through irradiation tests that were conducted as part of the Light Water Breeder Reactor and Advanced Water Breeder Applications programs. Also included are summaries of reports for several of the tests. The fuel was irradiated at several reactors and includes a large variety of fuel compositions. Some of the fuel was sectioned for examination but the majority is intact. A small amount of the fuel is unirradiated. The test material currently stored at INTEC is contained in one fuel handling unit, a scrap storage liner. The intact fuel within this liner is stored in unsealed or sealed containers. The sectioned fuel within this liner is all stored in sealed containers.

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FIGURES

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ACRONYMS

ATR	Advanced Test Reactor
AWBA	Advanced Water Breeder Applications
BOL	beginning of life
CHORT	Corrosion and Hydriding of Reactor Tubing computerized corrosion analysis program
ETR	Engineering Test Reactor
INEEL	Idaho National Engineering and Environmental Laboratory
K_{eff}	The effective multiplication factor is a numerical value indicating how near a particular geometric configuration of nuclear material may be to sustaining a nuclear chain reactor (K_{eff} = 1.0 is a critical mass).
LDR	Long Duplex Rod
LSR	Long Small Rod
LWBR	Light Water Breeder Reactor
NLDR	New Long Duplex Rod
NRX	(Canadian) National Research Experimental (Reactor)
OD	outside diameter
OD/t	outside diameter/thickness (cladding)
PCI	pellet-cladding interaction
PWR	pressurized water reactor
RXA	recrystallization annealed
SP	Special Physics (Tests)
SRA	relief annealed
TD	theoretical density
U^D	depleted uranium
U^E	enriched uranium
U^N	natural uranium
w/o	weight percent

Appendix C

Scrap Storage Liner

C1. INTRODUCTION

Several irradiation tests were conducted as part of the Light Water Breeder Reactor (LWBR) and Advanced Water Breeder Applications (AWBA) programs. Most of the fuel rods used in these tests are contained in one cut fuel storage liner at the Idaho Nuclear Technology and Engineering Center. The cut fuel storage liner is also referred to as the scrap can or the LWBR "Type D" storage liner. The fuel handling unit identification number is engraved on the liner closure head. The can contains: (1) irradiated and unirradiated intact rods, (2) intact rods with intentional defects, (3) intact rod bundles, (4) and rod sections. Some of the rod sections are mounted in epoxy (Clayton 1982, WAPD-TM-1440). The intact rods and rod bundles are contained in 22 unsealed tubes and one special storage compartment within the storage liner in a configuration shown in Figure C-1 (Pruss 1987, WAPD-NRF(L)D-96 as revised by Babyak 1987, WAPD-NRF(L)D-110).

C2. TESTS

Over the course of the research, development, and testing program for the LWBR, 32 tests were conducted. Each test was conducted in a reactor that possessed the test conditions desired. Four different reactors were used. The Advanced Test Reactor (ATR), located at the Idaho National Engineering and Environmental Laboratory (INEEL), offers symmetrical experimental loops that enable a large number of samples to be irradiated at one time. The Engineering Test Reactor (ETR), also located at the INEEL, typically sustained a thermal operating level of 175 megawatts. Test rods were also irradiated at Shippingport Atomic Power Station, which operated two pressurized water reactor (PWR) cores and one LWBR core over the course of the station's life. The Canadian National Research Experimental (NRX) reactor at the Chalk River Nuclear Laboratory in Chalk River, Ontario, Canada, is owned and operated by Atomic Energy of Canada, Ltd. The reactor is equipped with several test loops that provide pressure, flow, and heat removal systems independent of the reactor for the irradiation of test specimens. The tests and the associated reactors are shown in Table C-1.

C3. FUEL ROD PROPERTIES

The test rods have varying properties. All the test rods had Zircaloy-4 cladding (recrystalliztion or stress relief annealed), ranging in thickness from 0.018 to 0.039 in. All the rods all also had an X-750 plenum spring, and all were pressurized with helium at beginning-of-life (BOL). Some of the test rods contained U-235, which ranged from about 1.92 to 30 wt% depending on the rod (most were about 93% enriched) and others contained U-233, which ranged from about 5 to 12% wt%. Uranium-233 enrichments were generally either 93.1% or 98.2% (see Table 3A of WAPD-NRF(L)D-5). The length, outer diameter, and other rod properties varied. Specific details about each of the rods can be found in the Fuel Receipt Criteria (WAPD-NRF(L)D-5, WAPD-NRF(L)D-96, WAPD-NRF(L)D-58), or in greater detail in the test reports, outlined below.

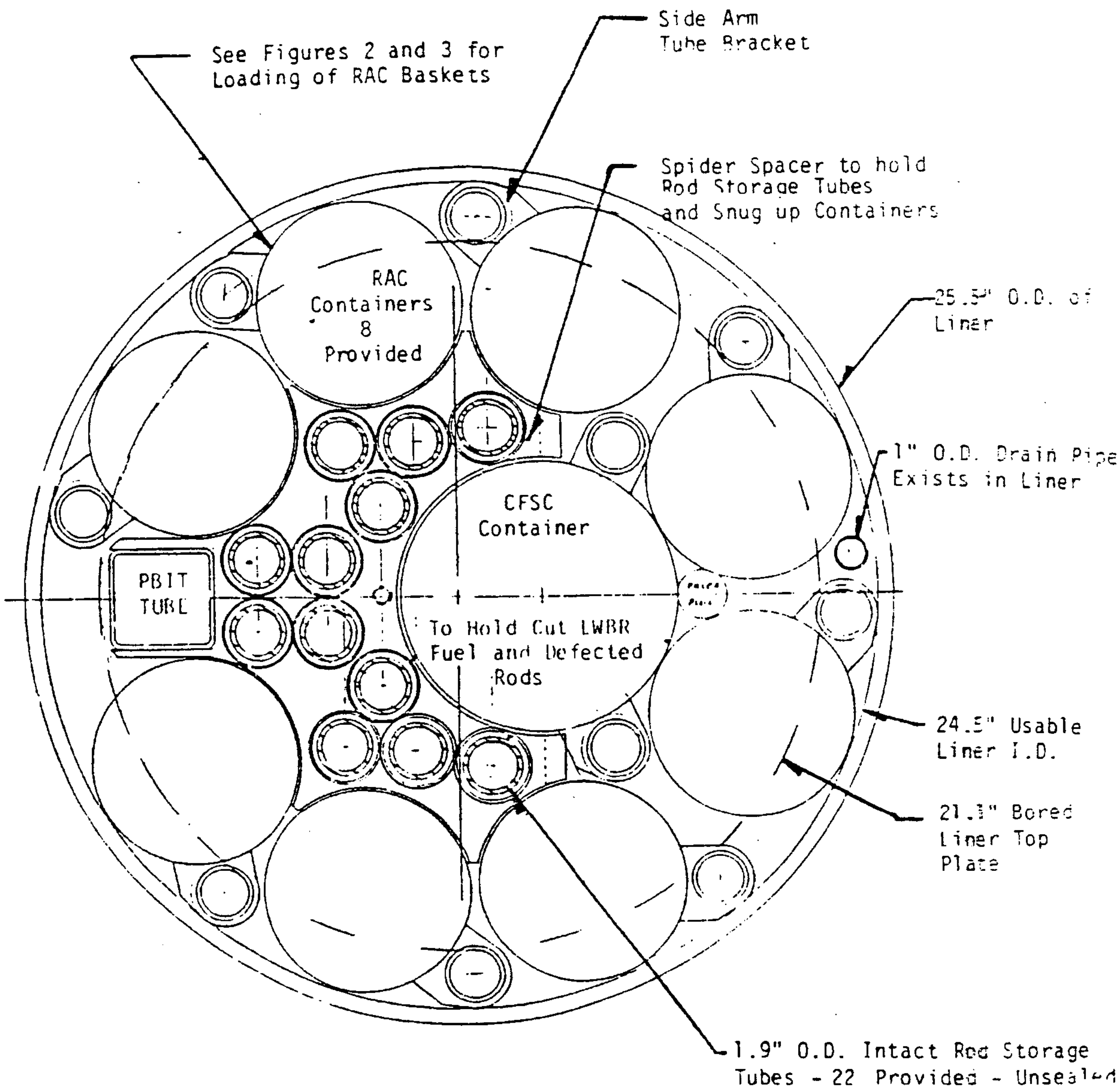

Figure C-1. Internal loading arrangement of the scrap canister.

Table C-1. Irradiation tests and associated reactor (Pruss 1987, WAPD-NRF(L)D-96 as revised by Babyak 1987, WAPD-NRF(L)D-110).

Test Identifier	Description	Reactor
ACT-LPR	Advanced concept test, long pressurized rods	NRX
ALT1	Alternate short rod screening test	ATR
ALT2	Alternate short rod screening test	ATR
B1	Blanket rod screening test	ETR
B1R	Blanket rod screening test	ETR
B1M	Blanket rod screening test	ETR
B3	Six-rod assembly test	ETR
B3A	Six-rod assembly test	ETR
BBT	Blanket bundle test	ETR
C7-LSBR	Large seed blanket reactor development	ETR
D1	Duplex short rod Screening test	ATR
GRIP-I	Grid rod in-pile test	ETR
GRIP-II	Grid rod in-pile test	ETR
GRIP-IIIA	Grid rod in-pile test	ETR
GRIP-IIIB	Grid rod in-pile test	ETR
GRIP-IIIC	Grid rod in-pile test	ETR and ATR
LBR	Long blanket rod test	NRX
LDR	Long duplex rod screening test	ETR
LSR	Long seed rod test	ETR
L12-LSBR	Large seed blanket reactor development	ETR
M13-S2	Seed rod screening test	ETR
M13-S2A	Seed rod screening test	ETR
M13-S3	Seed rod screening test	ETR
M13-S5	Seed rod touching test	ETR
NLBR	New long blanket rod test	NRX
NLDR-1	NRX long duplex rod test	NRX
NLDR-2	NRX long duplex rod test	NRX
NLDR-3	NRX long duplex rod test	NRX
NLDR-4	NRX long duplex rod test	NRX
NLSR	New long seed rod test	NRX
PBIT	Prebreeder bundle irradiation test	ATR
SABRE	Special assembly blanket rod elements	PWR C-1 S-4
SPIRE	Seed prototype irradiation rod experiment	ETR
SWLD	Blanket swing-load test	ETR
TIPPETT II	Thoria performance test	ETR
SIDR	Short intentionally defected rod test	NRX
PM	Power monitor-instrumented alloy rod	
SP	Special physics tests	

C4. IRRADIATED TEST REPORT SUMMARIES FOR SELECTED TESTS

C4.1 Comparison of Dimensional Changes in Fuel Rods with Predictions under Cyclic Conditions of Power and System Pressure
(Duncombe and Goldberg 1970, WAPD-TM-940)

Duncombe and Goldberg describe various additions for calculating ratcheting effects to CYGRO model; the effects include fuel cracking, clad collapse, friction between fuel and clad, clad anisotropy, and effects of neutron flux on clad creep. Physical, environmental, and operating characteristics of eight test rods are used to confirm the model. Three of the test rods (79-427, 79-430, and 79-468) are contained in the scrap canister. Physical characteristics of these rods are provided in Table C-2.

Table C-2. Physical characteristics of the rods.

Rod No.	Clad OD (in.)	Clad Thickness (mil)	Clad Type[a]	Fuel-Clad Diametric Gap (mil)	Fuel[b]	Fuel Density (% of theoretical)	Fuel Stack Length (in.)
79-427	0.600	24	SRA	4	ThO_2+1.98 w/o U^EO_2	98	29.8
79-430	0.600	24	RXA	10	ThO_2+1.98 w/o U^EO_2	98	29.8
79-468	0.600	24	SRA	11	ThO_2+3.42 w/o U^EO_2	98	84

a. Zircaloy-4 cladding, tube reduced, nominally 70% cold worked. SRA designates a stress relief at 950°F for 4 hours. RXA designates a recrystallization anneal at 1250°F for 4 hours.

b. Pressed and sintered pellets of length to diameter ratio between 1 and 2, with a 13-mil end-dish of 1.6 in. spherical radius.

Environmental and operating characteristics of scrap canister rods are given in Table C-3.

Table C-3. Environmental and operating characteristics of scrap canister rods.

Rod No.	Peak Heat Flux (10^3 Btu/hr-ft^2)	Peak Fuel Temp. (°F)[a]	Peak Fast Flux >1 Mev (10^{14} n/cm^2-s)	Peak Depletion[b] (10^{20} f/cc)	No. of Depressurizations (10 f/cc)
79-427	305	3075	1.21	0.37	2
79-430	301	3000	0.61	0.78	7
79-468	375	4525	0.15	1.94	15

a. Temperatures calculated using a computer program.

b. Calculated peak depletion at time of most recent examinations.

The results of the testing are as follows:

1. Mechanisms important to ratcheting were incorporated into the CYGRO model.

2. The observed progressive length increase of fuel rods having nonfreestanding clad compared satisfactorily with the model.

3. When gross axial wrinkling is observed, the model is less exact; this may be expected because the size and nature of the fuel-clad contact forces are inherently less well known.

4. The choice of parameters that lead to correct axial elongation prediction often do not lead to good prediction of diameter shrinkage; this is believed to be associated with observed clad nonuniformity, such as ridging, ovalness and wrinkling, which invalidate the model to an extent depending on their severity.

5. Further progress may result from improved analysis of axial and circumferential nonuniformity, more accurate representation of clad collapse characteristics, and improved knowledge of the in-pile creep properties of fuel and clad.

C4.2 In-Pile Dimensional Changes of Zircaloy-4 Tubing Having Low Hoop Stresses (Daniel 1970, WAPD-TM-973)

Short screening rods were irradiated in the M13 test loop of the ETR. The Long Small Rod (LSR) full-length rods were irradiated in the E25 test loop of the Canadian NRX reactor. The test identifier and the fuel rods used are given in Table C-4.

Table C-4. Test name and fuel rod identification numbers.

Test	No. of Rods	No. Rods in Scrap Canister	IDs of Rods
M13-S2	14	7	79-316, 79-317, 79-319, 79-322D, 79-399, 79-400, and 79-401
M13-S2A	11	9	79-377, 79-378, 79-379, 79-381, 79-383, 79-385, 79-386, 79-390, and 79-394
M13-S3	14	7	79-332, 79-337, 79-340, 79-435, 79-436, 79-437, and 79-438
M13-S3A	10	3	79-485, 79-491, and 79-493
M13-S4	7	0	0
LSR	6	3	79-432, 79-433D, and 79-434

Several of the test rods were intentionally defected before irradiation by drilling a 5-mil-diameter hole through the cladding after preirradiation corrosion testing. These rods are identified by the letter "D" following the rod number. Summary irradiation histories of the fuel rods are given by Daniel (1970).

The results of the testing are as follows:

- Comparison of length and diameter changes indicates that the diametric shrinkage of the short 0.25-in. OD rods were due entirely to the external pressure, reaching a maximum of about 1-mil (0.4%) at 17×10^{20} fast nvt.

- Diametric shrinkage in the bottom and middle regions of the long 0.25-in. OD rods was influenced by axial tensile stresses, imposed on the cladding by the fuel. This fuel-clad interaction increased the generalized stress over that imposed by the external pressure. Near 2×10^{20} fast nvt, shrinkage was about 6 mil (0.2%) in the absence of fuel-clad interactions but increased to about 2 mil (0.8%) in the presence of such interactions. A model using a modified version of CYGRO was proposed for simulating the performance of these rods.

- The component of the length increase caused by zircaloy growth was about 0.075% at 17×10^{20} fast nvt.

C4.3 In-Pile Dimensional Changes of ThO_2-UO_2 Fuel Rods with Nonfreestanding Cladding (Giovengo 1970, WAPD-TM-986)

Axial ratcheting is the progressive extension or elongation of fuel rods in-pile under cyclic conditions of power and system pressure resulting from irradiation. Axial ratcheting is made up of three components: (1) stress-free zircaloy growth, (2) diameter shrinkage due to system pressure, and (3) fuel-clad interaction. Data were presented for three series of irradiation testing of fuel rods with nonfreestanding cladding: the C7, NRX, and B1 series of tests. A physical description of the fuel rods along with a summary of the operational and measurement data is given. Rods used in this test are identified in Table C-5.

Table C-5. Fuel rods for in-pile testing.

Test	No. of Rods	No. of Rods in the Scrap Canister	Rod Identification Numbers
C7-B3	5	5	79-299, 79-300, 79-302, 79-304 and 79-308
C7-B3A	9	9	79-349, 79-350, 79-352, 79-353, 79-356, 79-374, 79-375, 79-376 and 79-405
NRX	6	3	79-310, 79-467, 79-468, 79-495, 79-575 and 79-576
B1	4	2	79-427, 79-428, 79-429 and 79-430
B1RA	1	1	79-577
B1RB	2	2	79-572, 79-579 and 79-581, 79-586

The results of the testing are as follows:

- Annealed cladding and low fast-flux environment resulted in the maximum amount of elongation.

- Cold-worked cladding and low fast-flux environment resulted in the least amount of elongation.

- Both cold-worked and annealed cladding resulted in elongation in the midrange of the data.

- Flat-ended pellets resulted in substantially greater elongation than dished-end pellets.

- For flat-ended pellets high center temperature (>2500°F) resulted in elongation 2–3 times greater than rods operated at lower temperature (<2000°F).

- Fuel clad diametric gap and clad diameter-to-thickness ratio had a significant but less pronounced effect on ratcheting.
- Accelerated power cycling and fuel loading had no observed effect on ratcheting.
- Pressure cycling appears to be the predominant mechanism inducing elongation from fuel-clad interaction; a correlation could not be determined between the number of pressure cycles or cladding texture and the extent of ratcheting.

C4.4 Fuel Rod-Grid Interaction Wear: In-Reactor Tests (Stackhouse 1979, WAPD-TM-1347)

Wear of the zircaloy cladding of LWBR irradiation test fuel rods, resulting from relative motion between rod and rod support contacts, is reported. Measured wear depths were small, 0.0–2.7 mils, but are important in fuel element behavior assessment because of the local loss of cladding thickness as well as the effect on grid spring forces that laterally restrain the rods. An empirical wear analysis model, based on out-of-pile tests, is presented. The model was used to calculate the wear on the irradiation test fuel rods attributed to a combination of up-and-down motions resulting from power and pressure/temperature cycling of the test reactor, flow-induced vibrations, and assembly handling scratches. The calculated depths are generally deeper than the measured depths.

The LWBR core employs ordered arrays of long (10 ft), small diameter (0.3–0.8 in.), zircaloy clad, cylindrical fuel elements. The fuel rods are supported axially by threaded end connectors on the rods attached to either the top or the bottom base plate of a module assembly. Each rod is thus fixed at one end and free at the other end. Lateral support for the rods is provided by a series of supports, called grids, at several axial locations along the length of the rods. Each grid contains, for each rod, a hexagonal-shaped cell with a spring and opposing fixed reaction dimples set at 120 degrees circumferentially from the spring. The spring applies lateral force on the fuel rod in the cell to hold it firmly against the dimples, while allowing relative axial movement between the rod and grid support points during reactor operation. Interaction between the fuel rod and the supporting springs and dimples caused by fuel rod length changes and vibration can result in wear on the zircaloy cladding of the fuel rods. Wear of the AM-350 stainless steel grid contact points has been found by test experience to be negligible relative to the fuel rod cladding wear.

Cladding wear may be caused by the combined effects of three types of interaction between fuel rods and support grids: (1) handling scratches, often along the full rod length, that occur when fuel rods are initially pulled into the grid supports; (2) axial motion of the rod relative to the grid supports due to fuel rod axial expansion and contraction during reactor power cycles and pressure/temperature cycles; and (3) flow-induced vibratory wear.

Cladding wear is of concern (1) because the thinning of the cladding increases stresses in the thinned section with a consequent reduction in margin-to-failure stress limits, and (2) because of its contribution to a reduction in the grid spring fuel rod support force with potential for reduced rod-to-rod and rod-to-structure clearances. In addition, a complete loss of grid contact force may result in excessive fuel rod vibration, creating a potential wear/fretting condition, as demonstrated in out-of-pile wear tests.

Stackhouse presents fuel rod cladding wear data obtained from in-reactor rod bundles tested in the LWBR fuel element development program and compares these data to wear estimates predicted using a model developed from out-of-pile wear tests. The LWBR fuel rods were composed of high density ThO_2-UO_2 and ThO_2 fuel pellets contained within Zircaloy-4 tubes having outside diameters of about

0.30 or 0.57 in., and lengths of about 8 ft. The rods were precorrosion filmed before insertion into the grid supports prior to irradiation.

Wear measurements were obtained on 34 fuel rods; all but one of the fuel rods are in the scrap liner. The rods were supported laterally by AM-350 stainless steel grids using of hexagonal-shaped grid cells that contain a spring and two dimples, or two pairs of dimples, set at 120 degrees circumferential from each other. Altogether 1298 support contact points are represented by the 34 fuel rods examined. (The number of support contact points for each rod was determined by multiplying the number of spring and dimple reaction points at each grid level by the number of grid levels supporting the rod. Multiple sets of wear marks on several rods are also included in the total.) Only 176 contact points were directly measured. The remaining 1122 support contact points were not measured because they were undetectable or obviously shallow; these are assumed to have wear depths of 0.0-0.5 mils. Ninety-five percent of the wear spot depths are 1.0 mil or less, 4 % are 1.1–2.0 mils, and 1% are 2.1–2.7 mils deep.

During examination of the irradiated fuel rods, wear depths were measured at the free end grid levels and at other levels where visual examination indicated that significant cladding wear had occurred. Other cladding wear spots that appeared to be smaller than 0.5 mil in depth were usually not measured. For all but six of the 34 rods, maximum rod wear occurred at the free-end grid support location. The occurrence of maximum wear at the rod free ends is attributed to the fact that this location is where the longest rod axial movement relative to grids occurs during power and pressure/temperature cycling, with resulting higher reciprocating wear. Flow-induced vibration wear also is expected to be a maximum at the free end of top mounted rods because of rod excitation by coolant flow impingement on the ends of the rods.

Wear mark depth was measured nondestructively with a profilometer considered to have an accuracy of ±0.2 mils. In addition, destructive examination of wear depth was performed metallographically on some rods by polishing transverse rod sections through the wear mark in successive planes about 20–30 mils apart. Photomicrographs taken at each plane were measured to obtain wear depth. The profilometry measurements agreed well with metallographic measurements.

All wear measurements and their location with respect to individual grids and to grid springs and dimple reaction points, are given by Stackhouse. Also given are test reactor exposure times, numbers of actual power and pressure/temperature cycles, stroke lengths, and measured overall rod length increases. The rod identification numbers are given in Table C-6 for 33 of the rods in the scrap canister that were used for the wear measurements tests.

Table C-6. Rods used in wear measurements test.

79-610	79-621	79-630	79-440	79-444	79-455	79-509	79-517
79-613	79-622	79-631	79-441D	79-445	79-459	79-513	79-522
79-614D	79-623	79-632	79-442	79-449	79-502	79-514	79-524
79-617	79-624	79-439	79-443D	79-450	79-504D	79-516	79-572
79-619	79-586						

The conclusions drawn from the testing are as follows:

- Maximum measured wear depth on the irradiation-tested fuel rods supported in grids having geometry similar to the LWBR design was 2.7 mils and was located at the free-end grid support of a top-mounted fuel rod.

- Fuel rod wear was deepest at the rod free-end grid support on 28 of 34 rods.

- Top mounted rods had greater wear depth at the free-end grid support than bottom mounted rods. This condition is attributed to greater vibratory wear experienced by the top mounted rods due to impingement of the coolant flow on the bottom free-ends of these rods.

- Wear depth on fuel rods that accumulated a high number of EFPH or power and pressure/temperature cycles was not significantly greater than that on rods with shorter test lives. This behavior is in accordance with the basis for the wear analysis model and is a result of rod axial growth during reactor operation.

- Maximum-measured-wear depths were generally less than the total amount of wear predicted by a wear analysis model developed from out-of-pile reciprocating wear tests. The predicted values included reciprocating wear, plus an allowance for vibratory wear and assembly and handling scratches.

- A high proportion, about 95%, of the rod-grid contact points examined had low wear of less than one mil depth.

- High wear is sometimes found at contact points associated with off-nominal conditions such as high rod bowing or contacts between the rod and grid at other than the spring and dimples.

C4.5 Fission Gas Release From ThO_2 and ThO_2-UO_2 Fuels (Goldberg et al. 1982, WAPD-TM-1350)

Fission gas release data are presented from 51 fuel rods irradiated as part of the LWBR irradiation test program (23 of these fuel rods are contained in the scrap canister). The fuel rods were Zircaloy-4 clad and contained ThO_2 or ThO_2-UO_2 fuel pellets, with UO_2 compositions ranging from 2.0–24.7 w/o and fuel densities ranging from 77.8–98.7% of theoretical. Rod diameters ranged from 0.25–0.71 in. and fuel active lengths ranged from 3–84 in. Peak linear power outputs ranged from 2-22 kW/ft for peak fuel burnups up to 56,000 MWD/MTM. Measured fission gas release was quite low ranging from 0.1–5.2%. Fission gas release was higher at higher temperature and burnup and was lower at higher initial fuel density. No sensitivity to UO_2 composition was evidenced. A calculation model is described that includes terms to represent fission gas release as a function of temperature, using a diffusion model, and as a function of density to account for release due to knockout and recoil at free surfaces. The model is developed on both a best estimate and bounding basis.

The amount of fission gases released from oxide fuel pellets during irradiation in power reactors is important to reactor design primarily in two design areas. First, release of fission gases from the fuel to the internal rod compartment results in an increase in rod internal pressure with increasing burnup. The higher internal pressure increases proximity to material property limits for a postulated loss of coolant accident, during which fuel rod cladding can potentially experience high temperatures, resulting in loss of strength and more susceptibility to swelling and rupture. Second, because fission gases (primarily xenon and krypton) have much lower thermal conductivity than the initial fill gas (typically helium or argon) used in light water reactor fuel rods, more fission gas release can result in higher operating fuel temperatures due to the degraded heat transfer in the fuel-cladding gap.

The report contains (1) data on fission gas release from ThO_2 or ThO_2-UO_2 fuels obtained from 51 fuel rods from the LWBR test program, and (2) comparisons of the measurements to a calculation model used in performance assessments. Dimensional, material characteristics, and environmental history of the test fuel rods are described. The fission gas release measurements are given along with a description of the measurement procedures and an assessment of measurement uncertainty. The calculation model is described, and the results of application of the model are compared to the measurements.

Measured fission gas release (measurement uncertainty of plus or minus 8% of nominal) was generally low, ranging from <0.1–5.2% of the fission gases theoretically produced by fissioning. Gas release was predominantly below 2% for high-density (95% theoretical or greater) fuels. Fission gas release was higher at higher temperatures, higher burnup, and lower density. No sensitivity to UO_2 composition was observed.

A calculation model was presented that includes terms to represent fission gas release at both high temperatures (assuming a gas bubble diffusion model) and low temperatures (based on a recoil plus knockout mechanism). The high temperature term accounts for migrating gas bubbles that are released from the fuel due to intersection with a surface (e.g., cracks or open pores). Depending on specific fuel properties and burnup, critical temperatures for release of bubbles from dislocations and grain boundaries are calculated.

The low temperature term is adapted from a model that assumes that fission gas is released by recoil and knockout at free surfaces. Pellet density initially serves as a measure of free surface area, which increases with burnup (presumably due to fuel cracking). The model is developed on both a best estimate and bounding basis.

Gas release for long rods, which experience nonuniform power profiles, is calculated in several axial segments (using average power generation for each segment) and integrated along rod length. The best-estimate model fits through the middle of the scattered data. All data are conservatively bounded by the bounding model.

C4.5.1 Rod Characteristics

Test fuel rods from the LWBR development program were Zircaloy-4 clad, nonpressurized (one atmosphere of helium, initial fill) and contained ThO_2 or ThO_2-UO_2 fuel pellets. Rod characteristics are summarized in the report for the 51 rods for which fission gas release data was obtained (23 of the fuel rods are contained in the scrap canister). The fuel rods are grouped by fuel type (100% ThO_2, ThO_2 + $^{233}UO_2$ and ThO_2 + $^{235}UO_2$). The identification numbers of the 23 rods contained in the scrap canister are given in Table C-7. (In the scrap canister there are no 100% ThO_2, three ThO_2 + $^{233}UO_2$ [the first three below], and the rest are ThO_2 + $^{235}UO_2$ fuel rods).

Table C-7. Rods used in testing.

79-442	79-509	79-570	79-576	79-613	79-632
79-445	79-513	79-572	79-605	79-617	79-656
79-449	79-514	79-573	79-608	79-623	79-671
79-349	79-522	79-575	79-610	79-631	

Fuel characteristics given for each rod are composition, pellet density, pellet dimensions, and in-core fuel pellet stack length. Fuel compositions ranged from pure thoria to about 25 w/o UO_2. Fuel densities were generally 95–98% theoretical oxide density (10.0 g/cc-ThO_2 and 10.24 g/cc-ThO_2 + 25 w/o UO_2). Nominal fuel pellet dimensions are given, including end-face geometry (flat or dished, with

4–22 mil dish depth). Fuel pellet diameters were 0.21–0.65 in., with length/diameter ratios of 1.0–3.0. In-core fuel pellet stack length ranged from about 3–7 in. in short rods and from 30–84 in. in long rods.

Cladding heat treatment (RXA-recrystallization anneal or SRA-stress relief anneal), outside diameter, and diameter to wall thickness ratio are given for each rod. Rod diameters ranged from about 0.25–0.71 in., with cladding OD/t ratios of 12–25. As-fabricated fuel-cladding diametric gaps were 2–10 mils. Fuel-cladding diametric gaps (no direct contact) are a source of thermal impedance and lead to higher fuel temperatures and greater gas release. Cladding OD/t and heat treatment affect the rate of creep down of the cladding diameter (under external pressure) and thereby the fuel-cladding diametric gap and gas release.

C4.5.2 Rod Operating Parameters

The test rods for the fission gas tests were irradiated in three different test reactors: (1) the ETR, (2) the ATR, and (3) the NRX. In-pile operating times ranged from <1000 to ~20,000 hours under nominal coolant conditions of 2000 psi and 550°F. Individual rod operating parameters are summarized in the report.

Peak and average axial linear power and fuel burnup are reported for each rod. Axial average values are equal to peak values for short rods, but are about 0.6–0.9 times the peak values for long rods. Peak linear power of most rods ranged from 2–15 kW/ft; 4 of the 51 rods were higher than 15 kW/ft up to a maximum of 22 kW/ft. Peak burnup ranged from about 1,000–56,000 MWD/MTM.

Peak values (axial position and operating history) of fuel temperatures at the rod centerline and pellet surface were calculated using the CYGRO (Newman, Giovengo, and Comden 1977)/FIGRO (Goldberg 1969, WAPD-TM-757) computer programs. (Time averaged temperatures are about 80% of peak temperatures.) Centerline fuel temperatures at the peak axial power locations ranged from <2000 to over 4000°F and fuel pellet surface temperatures ranged from about 800–1800°F. These temperatures are low relative to the thoria-based oxide melting temperatures (about 5900°F) so that no significant fuel redistributions due to pellet coring or melting were expected.

The ThO_2 dislocation release temperature (for release of gas bubbles from dislocations) was also calculated for each rod, assuming peak conditions and using the model by Warner (1969) WAPD-TM-805. This temperature provides a measure of fractional fuel pellet volume for intermediate-high-temperature fission gas release. The ThO_2 dislocation release temperatures range from about 2630–2930°F.

C4.5.3 Findings

The conclusions drawn from the testing within the range of parameters tested for 51 fuel rods are as follows:

- Fission gas release is greater at higher fuel temperatures and burnups. These effects can be satisfactorily predicted by a model that accounts for gas bubble-coalescence, release from grain boundaries, and dislocations.

- Higher initial fuel density results in significantly less fission gas release. This effect can be satisfactorily predicted by a model that accounts for release due to recoil and knockout of gas bubbles at free surfaces.

- No sensitivity to UO_2 composition or rod diameter was observed.

Additional testing (Goldberg et al. 1979, WAPD-TM-1350ADD) was conducted on three fuel rods (79-349, 79-375, and 79-405). All three rods are contained in the scrap canister; 79-349 was included in the first gas testing. These rods experienced relatively high-constant-peak power (18–22 kW/ft). The data indicate that at these high powers (and thus high fuel temperatures), ThO_2-UO_2, 92-95% of theoretical density, experiences equiaxed grain growth and relatively high fission gas release (up to 15%). These data supplement the data on the 51 fuel rods from above, which indicated low fission gas release(from 0.1–5.2%) for operation predominately below 14 kW/ft.

C4.6 Irradiation Testing of Internally Pressurized and/or Graphite Coated Zircaloy-4 Clad Fuel Rods in the NRX Reactor (from Hoffman and Sherman 1978, WAPD-TM-1376)

Alternate fuel rod design concepts were explored to improve performance capability for commercial scale light water prebreeder cores to efficiently produce ^{233}U from thoria. The initial screening tests used three fuel rods and two previously tested rods. The three rods (79-584, 79-706, and 79-707) were assembled from spare components previously fabricated for an LWBR blanket irradiation test to provide a basis for comparison with two previously irradiated, noncoated, nonpressurized rods, one of which was intentionally defected (79-583D and 79-587). All five rods are contained in the scrap liner. The rod identification and basic feature of the rods follows:

- Prepressurized with helium to 500 psi at room temperature
- Graphite barrier coating on the cladding inside surface
- Combined prepressurization and graphite coating
- Previously irradiated, noncoated, nonpressurized rod, and intentionally defected (79-583D)
- Previously irradiated, noncoated, and nonpressurized rod.

The helium pressurization, which is standard commercial practice, prevents collapse into unsupported gaps, delays fuel-cladding interaction due to reduced cladding pressure differential and mitigates the reduction of the thermal conductivity of the gas mixture in the fuel-cladding gap with depletion. The graphite coating provides lubrication of the fuel-cladding interface, thereby reducing fuel-cladding interaction, and may provide a barrier to fission product stress corrosion attack of the cladding. The tests of pressurized rods were directed at investigation of fuel rod performance, and were not focused on thermal-hydraulic considerations.

The fuel was ThO_2-3.06 w/o UO_2 at a density of 95–98% of theoretical density. The fuel stack contained 84 in. of ThO_2-UO_2 pellets with thoria pellets above and below the ThO_2-UO_2 fuel stack. A 10-in. plenum incorporating a Fe-Ni-Cr alloy hold-down spring was present at the top of the stack.

The three test rods (79-584, 79-706, and 79-707) were irradiated, one rod at a time, in the NRX reactor. The coolant was 2000-psi water at an average temperature of 560°F with a pH of 10.1–10.3 maintained by NH_4OH. Flow velocity was 19.6 ft/s. Each rod was irradiated for about 100 full power days at peak linear power output of 13–14 kW/ft. Power was then increased by 30% to 17–18 kW/ft to simulate the increased power in an up-power maneuver. The power was maintained at the 30% higher level for about 40 full power days, and the rods reached a peak depletion of 1.5×10^{20} f/cc (5800 MWD/MT) and a peak, fast fluence (>1 Mev) of 1.9×10 n/cm^2. Rods 79-583D and 79-587 experienced similar histories except that 79-583D, the intentionally defected rod, did not experience the up-power maneuver. All rods were periodically removed from testing during reactor shutdowns and examined at Chalk River; these measurements included both rod length and diameter.

Based on comparisons between the nonpressurized, noncoated rod (79-587) and the prepressurized and graphite coated rod (79-707), initial prepressurization with helium plus graphite coating the inside cladding surface reduce both overall axial cladding strains and peak axial cladding strains. Diameter changes have also been significantly reduced. These reductions are attributed to reduced fuel-cladding interaction and possible enhanced fuel densification due to the relatively higher gas pressure on the fuel pellets. Either prepressurization or graphite coating by itself resulted in an intermediate level of improvement from the nonpressurized, noncoated rod, but these comparisons are not as direct due to differences in fuel-cladding gap size.

C4.7 Early-In-Life Performance of Short Rod Duplex Pellet Screening (D-1) Test (Sphar and Sherman 1979, WAPD-TM-1378)

To support the development of the duplex pellet fuel element, a screening irradiation test was designed, fabricated, and irradiated in the ATR at the Idaho National Engineering Laboratory. The test consisted of 21 rods irradiated in three holders of seven rods each in a single ATR test loop. The length of the rods was restricted to 11 in. to allow a greater number of rods and thus a greater number of variables to be tested. Duplex pellet annuli of three different compositions was included. The seven rods of the first holder contained UO_2 annuli; the second holder contained UO_2- ZrO_2 annuli; and the third contained UO_2-ZrO_2-CaO annuli. Other test parameters were:

- Two levels of rod internal prepressurization (100 and 500 psig at room temperature)
- Two types of zircaloy cladding heat treatment and diameter to thickness ratio (stress relief annealed with OD/t = 16.0 and recrystallized annealed with OD/t = 13.9)
- Thoria spacers of three different thicknesses for separating duplex pellets axially to maintain axial alignment of the annulus and central core (0.05 in., 0.1 in., and 0.5 in.)
- Varying initial diametric clearance gap between the annulus and cladding (45–85 mils) and between the annulus and central pellet (21–102 mils).

The D-1 duplex pellet-screening test used 21 fuel elements (16 are in the scrap canister) 11 in. in length and 0.3 in. in diameter. The rods consisted of top and bottom Zircaloy-4 end-closures welded into seamless Zircaloy-4 cladding. Contained within the cladding was an 8-in. stack of fuel pellets and a 0.785-in. long plenum region containing an Inconel-X hold-down spring. All 21-test rods were irradiated simultaneously for 32.6 days in the ATR at the INEEL. The rods operated at 13–15 kW/ft reaching depletion of $1.2–1.3 \times 10^{20}$ f/cc averaged over the total duplex pellet volume and ~$2.4\text{-}2.6 \times 10^{20}$ f/cc in the annulus. The fast neutron fluence (E >1 Mev) exposure of the rods ranged from $2.8–3.9 \times 10^{20}$ n/cm^2. The coolant was water pressurized to 2000 psi at an average temperature of 520°F. Coolant velocity past the rods was 18 ft/s. Following irradiation, the 21 rods were subjected to nondestructive examination. In addition, one rod of each annulus composition type was subjected to destructive examination. Nondestructive examinations consisted of:

- Visual inspections
- Dimensional measurements

- Neutron radiography
- Gamma ray scanning.

Destructive examinations consisted of:

- Collection and analysis of the rod internal atmosphere to determine fission gas release
- Depletion analysis
- Cladding fluence determination
- Metallographic evaluation of fuel components and cladding.

Visual examinations of the rods as removed from the reactor revealed a thin gray layer of crud that was readily removed by wiping with alcohol soaked cloths. Removal of the crud layer revealed lustrous black oxide surfaces not noticeably different from the preirradiation condition. Rod average diameter changes were small, the greatest being a decrease of 0.52 mil. The changes correlated with cladding properties, fast fluence, and rod internal pressure as was expected in the absence of fuel-cladding interaction. Averaged diameter changes for rods in each cladding type-internal pressurization category agreed with calculations to within 0.24 mil.

Rod lengths increased by as much as 0.061% and, as in the case of diameter, correlated with cladding properties, fluence, and rod internal pressure. Predicted length increases by stress-free zircaloy growth, and elongation caused by the diameter change and anisotropy of the cladding material, were larger than the measured changes by factors of 1.5–2.9. However, the length changes were small, and the over-prediction represented only 0.02–0.05% strain.

Neutron radiography revealed no evidence of fuel redistribution and melting. Cracking of the annuli of all three compositions was observed with the maximum degree of cracking noted in the UO_2-ZrO_2 annuli. Fuel stack lengths in the UO_2 annulus rods and in the UO_2-ZrO_2-CaO annulus rods decreased on the average by 0.22 and 0.40% respectively. The fuel stacks in the UO_2-ZrO_2 annulus rods showed an average length increase of 0.41%. There is no basis for expecting expansion of the fuel stacks in the UO_2-ZrO_2 rods, and the length increase is believed to be associated with the significantly greater cracking observed for this fuel material and small separations of fuel pieces.

Gamma scans, performed primarily to determine the axial power shape in the rods, indicated that peak to minimum duplex pellet power in the rods was less than 1.25. This indicates that the differential neutron shrouding employed during irradiation to offset the basic neutron flux profile of the test reactor was effective.

Destructive analysis for depletion and fluence was completed for the UO_2 annulus rod. The measured depletion was 1.27×10^{20} f/cc of compartment (compartment is defined as: the volume inside the cladding per unit length of duplex pellet). The depletion implies a time-averaged rod power level of 14.4 kW/ft, in good agreement with the desired power level. The measured fast neutron fluence experienced by the cladding was 3.9×10^{20} n/cm^2, which corresponds to a time-averaged neutron flux of 1.4×10^{14} n/cm^2-s.

The percentage of fission gas released from the fuel was measured on one rod of each fuel type. Results are presented in Table C-8.

Table C-8. Percent of fission gas released from rods.

Rod Type	Rod ID	Fission Gas Release
UO_2	97-23	0.06%
UO_2-ZrO_2	97-22	0.21%
UO_2-ZrO_2-CaO	97-37	0.39%

These low values indicate that the annulus temperatures were below the temperatures at which substantial migration of gas from dislocation and grain boundaries occurs.

Hydrogen concentration in the cladding of all three rods was about 25 ppm, which is consistent with the as-received content plus the expected hydrogen pickup in the preirradiation corrosion test and 32.6 days of in-pile operation. No change in cladding grain size was observed.

Oxide formation on the outside surface of the cladding for all three rods was observed to be 1 micron or less. About 0.5 micron was present in the preirradiation condition based on the rod weight gain during preirradiation corrosion testing. On the clad inside surfaces, oxide formation was irregular, varying from no discernible thickness over most of the surface to isolated patches with maximum thickness of 7 microns. The oxide formation was presumably caused by oxygen, produced during fission and released from the fuel, collecting at the cladding.

Metallographic evaluation of the microstructure of the ThO_2 central pellets and spacers from all three rods indicated little change, if any, from the preirradiation condition. Porosity did not appear to have changed during irradiation. Grain size after irradiation varied in the range ASTM 6-10 (13–50 microns) compared to a preirradiation size range of ASTM 5-11 (9–70 microns) with no evidence of equiaxed or columnar grain growth.

Comparison of pre- and postirradiation annulus porosity was made by means of a Quantimet Television Microscope analysis of pore volume. For the UO_2 rod, total porosity volume in the annulus decreased to about 70% of the preirradiation value near the outer surface and to 40–50% in the inner regions. The average diameter of the remaining pores was not appreciably different from the average preirradiation pore diameter. The postirradiation grain size (12 microns average) was uniform and there was no evidence of change in grain size with irradiation. The porosity in the irradiated fuel was observed to be located primarily at the grain boundaries whereas both intra-granular and inter-granular pores existed in the preirradiation condition.

In the UO_2-ZrO_2-CaO annulus rod, Quantimet analysis showed an overall porosity decrease to about one-third of the preirradiation value, essentially equal to the decrease observed in the UO_2 annulus. The porosity change was not uniform across the annulus wall thickness; it varied from a decrease to one-half at the outside surface to one-fifth near the inside surface. The grain in the UO_2-ZrO_2-CaO fuel in the postirradiation condition was ~40 microns (on the average), and there was no evidence of grain growth.

In the UO_2-ZrO_2 annulus rod, the preirradiation porosity was uniform across the annulus thickness but the pore size was significantly larger than the pore sizes in the UO_2 and UO_2-ZrO_2-CaO fuels. After irradiation, porosity appears to have been essentially eliminated. In addition, the lateral surfaces of the UO_2-ZrO_2 annulus show an irregular shape distinctly different from the other annulus materials. This may be due to nonuniform shrinkage associated with the greater UO_2-ZrO_2 densification and lower in-pile creep strength as compared to the UO_2 and UO_2-ZrO_2-CaO fuels. The average preirradiation grain size of the UO_2-ZrO_2 material was about 11 microns. After irradiation, etching of the fuel failed to reveal grain structure. The lack of UO_2-ZrO_2 post-irradiation grain structure is consistent with prior experience and may be associated with the phase transformation.

Based on the densification implied by the Quantimet analysis of metallographic samples, and the assumed isotropic volume change and fuel swelling component of 0.7-percent $\Delta v/v$ per 10 f/cc, expected fuel stack length changes were derived and compared to the measured length changes with results as given in Table C-9.

Table C-9. Expected and measured fuel stack length changes.

		Fuel Stack Length Change	
Rod Type	Rod ID	Derived from Densification Measurements	Measured from Neutron Radiographs
UO_2	97-23	-0.5	-0.22
UO_2-ZrO_2	97-22	-1.7	+0.41
UO_2-ZrO_2-CaO	97-37	-0.7	-0.40

For the UO_2 and UO_2-ZrO_2-CaO rods, the measured stack shrinkage is 0.3% less than that implied by the net effect of densification and swelling. For the UO_2-ZrO_2 rods, the discrepancy is 2.1%. However, the measurements from the radiographs include the effects of annulus cracks and associated small separations. The large discrepancy for the UO_2-ZrO_2 fuel is probably because it was more extensively cracked than the other fuels.

In summary, examination of the 21 rods of the D-1 test after irradiation at 13–15 kW/ft for 32.6 days to peak depletions of $1.2–1.3 \times 10^{20}$ f/cc and fast neutron fluences of $2.8–3.9 \times 10^{20}$ n/cm^2 revealed no deficiencies in the early-in-life performance of rods with duplex pellets. The UO_2-ZrO_2 annuli duplex pellets had greater densification than the other two fuel types; however, this did not result in detrimental performance such as excessive operating temperatures or enhanced fission gas release.

The rod identification numbers of the 16 rods of this test contained in the scrap canister are given in Table C-10.

Table C-10. Rod identification numbers of rods from this test that are in the scrap canister.

97-1	97-19	97-23	97-36D
97-12	97-20	97-25	97-37
97-16	97-21	97-31	97-40
97-16	97-22	97-34	97-42

C4.8 Cladding Corrosion and Hydriding in Irradiated Defected Zircaloy Fuel Rods (Clayton 1985, WAPD-TM-1393)

Twenty-one LWBR irradiation test rods containing ThO_2-UO_2 fuel and zircaloy cladding with holes or cracks operated successfully. Zircaloy cladding corrosion on the inside and outside diameter surfaces and hydrogen pickup in the cladding were measured. The observed outer surface zircaloy cladding corrosion oxide thickness of the test rods were similar to thickness measured for nondefected irradiation test rods. An analysis model, which was developed to calculate outer surface oxide thickness of nondefected rods, gave results that were in reasonable agreement with the outer surface oxide thickness of defected rods. When the analysis procedure was modified to account for additional corrosion proportional to fission rate and to time, the calculated values agreed well with measured inner-oxide corrosion film values. Hydrogen pickup in the defected rods was not directly proportional to local corrosion oxide weight gain as was the case for nondefected rods.

The rod identification numbers of the rods in the scrap canister are given in Table C-11.

Table C-11. Rod identification numbers.

79-301D	79-353	79-504D	79-609D
79-307D	79-441D	79-583D	79-614D
79-322D	79-433D	79-587	

Note: Rods 79-353 and 79-587 defected in-service

Nuclear power reactors are designed, manufactured, and operated to avoid conditions known to cause in-pile fuel rod cladding defects. Stringent controls on manufacturing and inspection minimize the probability of cladding fabrication defects. However, defected fuel rods (i.e., where the cladding has a through-thickness hole or crack) have occasionally occurred in both test reactors and commercial power reactors. In the event of a cladding defect, coolant can enter the rod interior and hence the cladding internal surface is subject to oxide corrosion and hydrogen pickup. Most defected zircaloy fuel rods operated satisfactorily until removal during a normal refueling. However, under certain conditions zircaloy cladding may be degraded over time and pose a threat to continued operation. Therefore, the operational behavior of defected fuel rods is an important engineering consideration for a reactor core.

The report summarizes the cladding corrosion and hydriding results of the LWBR irradiation test program on defected ThO_2-UO_2- fueled Zircaloy-4 clad rods. Two major consequences of defected rod operation, internal surface cladding corrosion and cladding hydrogen pickup, were examined to determine if defected fuel rod corrosion rates and hydrogen pickup behave similarly to those of nondefected Zircaloy-4 rods; the nondefected rods are exposed to coolant on their outer diameter surfaces only. Cladding corrosion film thickness and hydrogen content measurement on intentionally defected Zircaloy-clad fuel rods from the LWBR irradiation test program are compared with values calculated by a computerized corrosion analysis procedure designated as CHORT (Corrosion and Hydriding of Reactor Tubing). The CHORT procedure was based on corrosion and hydriding data from nondefected irradiation test rods with only the outer cladding surface exposed to coolant. Predictions of corrosion oxide thickness are in reasonable agreement with measured data. However, hydrogen pickup in defected fuel rods was observed to behave differently than in nondefected rods. Unexpectedly high hydrogen concentration in cladding at low power segments of certain defected Zircaloy-4 fuel rods was observed and is attributed to gaseous hydrogen transport along the fuel rod cladding gap.

C4.8.1 Defected Fuel Rod Corrosion and Hydriding

A defect is defined as a breach of cladding integrity, i.e., a perforation, slit, or pinhole, that usually leaks fission products to the coolant and coolant to the rod internals. A defected zircaloy-clad fuel rod experiences greater cladding corrosion and hydriding than a normal nondefected rod because both inside and outside cladding surfaces are exposed to coolant. The amount of corrosion and hydriding on the outside surface of a defected fuel rod should be about the same as on a nondefected rod because the conditions are the same. If a defect occurs in the cladding, coolant may enter the fuel rod and reach high temperature when the core is taken to power. Corrosion and hydriding on the inside surface of the cladding will then occur at a faster rate than on the outside cladding surface; this is due to higher temperatures at the inner surface because of fissions on or very near the corroding surface.

The Shippingport LWBR core contained 12 hexagonal-shaped modules, which were arranged in a symmetric array, surrounded by 15 reflector modules. Each of the hexagonal modules contained a central movable fuel assembly (seed) surrounded by a stationary blanket assembly. The fuel was in the form of ceramic pellets that were sealed within Zircaloy-4 tubes. In the seed and blanket regions, the fuel pellets were composed of the mixed oxides of ^{233}U and ^{232}Th in solid solution. In the reflector region and in short sections at the tops and bottoms of the seed and blanket fuel rods, the pellets were ThO_2. The seed-blanket-reflector configuration of the LWBR core had 17,287 fuel rods. LWBR fuel rod cladding was used in two metallurgical conditions, recrystallization annealed (RXA) seed rod tubing and stress-relief annealed (SRA) blanket and reflector rod tubing. Fuel rods were maintained in close-packed hexagonal arrays by AM-350 stainless steel grids. The LWBR core operated for about 29,000 EFPH. The absence of high coolant activity indicated that there were no fuel rod cladding defects.

Hydrogen transport through the fuel-cladding gap can also occur in irradiated defected fuel rods by the following sequence of events. First coolant enters the rod through the defect and oxidizes the inner zircaloy cladding surface through the reaction: $Zr + 2H_2O \rightarrow ZrO_2 + 2H_2$. The hydrogen that is not absorbed by the zircaloy (about 75%) is released to the fuel-cladding gap, thus enriching the atmosphere in hydrogen. In addition, some of the coolant entering the defect is decomposed to hydrogen and peroxide by radiolysis, $2H_2O \rightarrow H_2O_2 + H_2$. Thus the oxidant partial pressure is reduced both by corrosion of the internal surface of the zircaloy cladding and by peroxide oxidation of the fuel. High levels of free hydrogen generated by the radiolysis of the coolant and fuel and cladding oxidation can migrate through the fuel-cladding gap to the end regions of the defected rod where the hydrogen is absorbed.

C4.8.2 Experimental Details

Irradiation testing of defected fuel rods played an important role in development of fuel elements for the LWBR core. The LWBR irradiation test program encompassed 30 individual tests of 271 fuel rods. The test rods were irradiated either in standard specimen holders or in bundles resembling portions of LWBR fuel rod modules. The coolant for these irradiation tests was pressurized water maintained at pH 10 by NH_4OH additions. Nineteen fuel rods (14 seed and 5 blanket) were intentionally defected with drilled holes prior to testing. A larger (~35 mil diameter) spotting hole was first drilled halfway through the cladding wall from the outside surface and then continued through the wall to the inside surface with a smaller (~5 mil diameter) defect hole. The fuel stacks of some of the defected rods were short (6–11 in. in length). However, five seed rods and four blanket rods were of LWBR length, i.e., up to 118 in. long. Holes were located about halfway up the fuel stack on short rods and within 24 in. of the bottom on long rods, except on seed rod 79-443D where the hole was located at the bottom end plug-pellet stack interface. In addition, two blanket rods, which were irradiated at higher heat ratings than LWBR core rods, developed small cladding defects during planned in-service transient testing.

All 21 defected rods successfully operated with limited radioactivity release to the coolant. Startup activities, i.e., the values measured immediately after a defected test rod reached full power following a shutdown, were 5–10 times greater than the steady state activities due to release of fission products to the coolant. These high activities declined over a period of 1 to 3 days to the steady state level. The steady state coolant activity values of irradiation tests with defected rods were higher than similar tests containing only nondefected rods. For example, the ^{138}Cs activity in the GRIP IIIA test with defected rod 79-614D was 1×10^5 dpm/mL compared to an activity value of 5×10^4 dpm/mL for the GRIP IIIC test with no defected rods. Irradiation histories of the 21 LWBR defected rods, including the two which defected in-pile, are given in the report. The fuel rods with intentionally fabricated defects are identified by the letter "D" after the rod number. The seed-size irradiation test rods with RXA cladding were irradiated to peak depletions up to 12×10^{20} f/cc and peak fast neutron (>l Mev) fluences up to 101×10^{20} n/cm^2. The peak depletion and fluence for the LWBR core seed rods were 11×10^{20} f/cc and 97×10^{21} n/cm^2, respectively. The blanket-size test rods with SRA cladding were irradiated to peak depletions up to 4×10^{20} f/cc and fluences up to 12×10^{20} n/cm^2. The peak depletion and fluence for the LWBR core blanket rods were 5×10^{20} f/cc and 74×10^{20} n/cm^2.

The objectives of the LWBR irradiation test program were:

- To test fuel rods under heat fluxes, fast neutron fluxes, and fuel depletions expected in the LWBR core
- To confirm satisfactory performance for design lifetime
- To support development of performance analyses for LWBR fuel rods.

The program for measuring corrosion and hydriding in Zircaloy-4 cladding of defected fuel rods consisted of rods from the 14 tests given in Table C-12.

Table C-12. LWBR defected irradiation tests containing fuel rods examined for cladding corrosion and hydriding.

Designation	Test Name	Rod Type	Heat Treat Cladding	Test Reactor
M-13-S2	Seed Rod Screening	Seed	RXA	ETR
M-13-S3	Seed Rod Screening	Seed	RXA	ETR
M-13-S3A	Seed Rod Screening	Seed	RXA	ETR
M-13-S4	Seed Rod Screening	Seed	RXA	ETR
GRIP II	Grid Rod In-Pile	Seed	RXA	ETR
GRIP IIIA	Grid Rod In-Pile	Seed	RXA	ETR
GRIP IIIB	Grid Rod In-Pile	Seed	RXA	ATR
LSR	Long Seed Rod	Seed	RXA	NRX
—	Production Thoria	Seed	RXA, SRA	ETR
C-7B3	Blanket Screening Test	Blanket	SRA	ETR
C7-B3A	Blanket 6-Rod Assembly	Blanket	SRA	ETR
C7-BBT	Blanket Bundle Test	Blanket	SRA	ETR
SBR	Short Blanket Rod	Blanket	SRA	NRX
NLBR	New Long Blanket Rod	Blanket	SRA	NRX

C4.8.3 Postirradiation Examination Results

All of the defected rods were visually examined. The inside and outside corrosion cladding-surface oxide thickness was measured for 16 of the defected rods on at or near the fuel rod peak power position. The same 16 rods were analyzed for hydrogen content and distribution. Summaries of internal and external cladding-corrosion data for the 16 LWBR irradiated defected test fuel rods that were destructively examined are presented for RXA and SRA Zircaloy-4 cladding. External corrosion-oxide thickness measured on the defected fuel rods was about the same as those of nondefected rods with similar irradiation histories.

Nine of the intentionally fabricated defected rods had a white or gray streak downstream from the defect hole (streamers). The defect hole streamer of GRIP IIIB Rod 79-609D was observed at the first interim examination (1330 EFPH). At 2360 hours, the streamer consisted of a bright white area and a darker phase extending downstream from the defect hole and increasing in width as the distance from the hole increased. With continued irradiation the white portion increased in area and covered the darker phase. Postirradiation examination confirmed the streamer to be ZrO_2. The nine oxide streamers were local and had no noticeable effect on general cladding integrity. It is thought that either eroded ThO_2 fuel or fission products emanating from the defect hole caused the accelerated corrosion of the zircaloy cladding.

Internal cladding surface oxide films in the defected rods were usually more variable in thickness and several times thicker than the external oxide films. The thicker inner-surface corrosion films are due to several factors: higher internal cladding surface temperatures (up to 780°F), fission-induced corrosion acceleration at the internal surface and exposure to a steam environment. The internal film on Rod 79-587, however, was thinner than the external film because the rod was removed from test about 8.5 hours following the planned up-power transient test that produced the defect. Four of the intentionally fabricated defected rods experienced cladding swelling. Rod 79-504D swelled along the primary fuel stack. Three rods (79-433D, 79-307D, and 79-583D) had periods of normal dimensional changes during irradiation before any significant swelling, mainly in the plenum region, was detected. Blockage or partial blockage of the defect hole occurred in all four rods. The combination of hole blockage and swelling is indicative of water logging, i.e., excessive internal pressure built up by trapped coolant, which deforms the cladding.

C4.8.4 Zircaloy-4 Cladding Hydriding

Measured hydrogen pickups in irradiated LWBR nondefected test rods and autoclaved Zircaloy-4 tubing specimens were proportional to measured outside diameter corrosion thickness. The hydriding in defected Zircaloy fuel rods falls into three categories: expected due to corrosion, accelerated, and massive. Expected hydrogen pickup in defected rods results from the additional hydrogen which enters the cladding through the inside diameter ZrO_2 film during corrosion. Twelve of the 16 destructively examined defected LWBR test rods exhibited normal behavior of this type (~100–1000 ppm H_2). Accelerated hydriding is defined as hydrogen absorption from the coolant far in excess of the nominal 25% pickup fraction of free H_2 produced by the Zr-H_2O corrosion reaction for Zircaloy-4 (~several thousand ppm). Massive hydriding is the formation of regions of delta phase zirconium hydride in the cladding due to grossly accelerated hydrogen pickup (16,300 ppm).

The hydrogen contents of Zircaloy-4 cladding samples from the LWBR intentionally defected test rods are summarized in the report. Measurements were made with a vacuum extraction technique and by visual comparison with known metallographic standards. Because of the greater internal surface corrosion, the total hydrogen contents in the defected rod cladding were several times those in nondefected rod cladding with similar irradiation histories. For example, in the GRIP-IIIA test, defected rod 79-614D had 174 ppm hydrogen in the peak power region, whereas companion nondefected rod 79-617 had only 40 ppm hydrogen. Hydrogen pickup in nondefected fuel rods is proportional to corrosion oxide thickness and, therefore, is greater in peak power positions than in cooler, low power regions. In contrast, several defected test rods (79-433D, 79-443D, 79-609D, and 79-614D), that were examined at several power positions, had higher hydrogen contents in cooler, low power cladding regions where the corrosion was less. Also, due to the steep temperature and higher hydrogen concentration radial gradients in defected rods, hydrogen tends to diffuse from the hotter inside cladding surface to the cooler outside surface; this results in higher hydrogen concentrations at the outside cladding surface.

Several instances of localized accelerated and massive hydriding were observed. Two intentionally fabricated defected fuel rods (GRIP-II rod 79-443D and GRIP-IIIB rod 79-609D) had areas of accelerated hydriding with several thousand ppm of hydrogen. Localized areas of massive hydriding were found in C7-B3A rod 79-353, GRIP-II rod 79-441D, and GRIP-IIIB rod 79-609D. These localized areas were converted to solid zirconium delta hydride (~16,300 ppm H_2). Massive hydriding was also accompanied by dimensional changes in these three rods due to the lower density of zirconium delta hydride compared with Zircaloy-4. However, none of these incidents interfered with the operation of the irradiation tests. For example, C7-B3A rod 79-353, which defected in-pile due to iodine stress-corrosion cracking, operated successfully for about 12,000 EFPH even though during postirradiation examination the cladding was observed to be massively hydrided near the bottom end of the rod. None of these hydrided rods lost additional structural integrity during operation, which attests to their ability to function under localized accelerated and massive hydriding conditions.

C4.8.5 Summary of Corrosion and Hydriding Behavior

Oxide films on internal surfaces of defected Zircaloy-4 fuel rods were several times as thick as films on external surfaces. This can be explained both by higher temperatures at the internal surface and by the effect of surface fissile enhancement.

Total hydrogen contents in defected fuel rod cladding were several times those in nondefected rod cladding. Further, evidence of hydrogen migration to cooler regions of the rods remote from the defect hole was observed, indicating that hydrogen pickup is not proportional to corrosion oxide thickness.

Hydrogen levels in the cladding of the defected fuel rods were generally higher at the external surface than at the internal surface because, in a sufficiently high thermal gradient, hydrogen diffuses toward the cooler region.

Defected rods with areas of accelerated or massive hydride continued to operate satisfactorily.

C4.8.6 Conclusions

- The measured outer surface zircaloy cladding corrosion oxide thickness of both defected and nondefected LWBR irradiation test rods were similar and can be calculated using a model based on nondefected outer surface corrosion experience.

- There is a significant corrosion enhancement on the inside-cladding surface in defected zircaloy fuel rods that can be attributed to radiation damage caused by fission product recoil.

- When modified to account for the additional corrosion caused by fission activity on the inner zircaloy cladding surface, a model qualified to the corrosion of nondefected rods provided calculated values that agree well with measured inner oxide corrosion film values.

- Hydrogen concentrations are higher than predicted in the lower power segments of defected zircaloy fuel rods and are not proportional to oxide thickness. This phenomenon is attributed to gaseous hydrogen transport through the fuel-cladding gap; this results in high hydrogen concentrations in the gap at the top and bottom ends of the defected rod.

- Hydrogen absorption models in which hydrogen pickup is calculated to be directly proportional to local corrosion oxide weight gain, while adequate for the prediction of external hydriding in nondefected rods, are unsuitable for prediction of axial hydrogen distribution in defected zircaloy rods.

C4.9 Iodine and Cesium in Oxide Fuel Pellets and Zircaloy-4 Cladding of Irradiated Fuel Rods (Ivak and Waldman 1979, WAPD-TM-1394)

Measurements of fission product iodine and cesium are reported for thoria and binary (ThO_2-UO_2) fuels with various irradiation histories. These volatile fission products were measured on the cladding surface or in the fuel by using specially developed radiochemical techniques. The radiochemical iodine measurements are in agreement with a theoretical iodine release model for irradiated fuel. Microprobe examinations of irradiated fuel rod cladding sections show fission product cesium to be located preferentially at the pellet to pellet interface region. Fission product iodine was detected in the interface microprobe-limit region of one sample but generally remained below the limit of detection.

Twenty-two fuel rods were analyzed for this report; ten of the 22 rods are contained in the scrap canister. The rod identification numbers of the 10 rods are listed in Table C-13.

Table C-13. Rod identification numbers.

79-353	79-449	79-576	79-605	79-617
79-442	79-572	79-587	79-610	79-671

Rod 79-587 failed in-pile during up-power transient.

The iodine and cesium concentrations obtained from radiochemical analysis of the 22 test-rods are given along with a summary of the irradiation history of each test rod. Electron microprobe examination of cladding segments from four irradiation test rods was also conducted to determine iodine and cesium distribution on the inside diameter surface of cladding. A brief summary of the results for two of the rods that are contained in the scrap canister is presented below.

Rod 79-442—One of the two locations, corresponding to a pellet interface location on the clad surface had only barely detectable amounts of cesium. The second interface location displayed only background levels. No iodine, cadmium, tellurium or mercury was detected above the background levels anywhere on the sample.

Rod 79-576—One of the two pellet-to-pellet interfaces on the cladding surface showed a relatively strong indication of cesium. No iodine, mercury, cadmium, or tellurium was detected above the sample background levels.

The conclusions of the report were as follows:

- There is essential agreement of microprobe evaluation with the low-level of iodine found by radiochemical analysis. Results of both radiochemical and microprobe examinations suggested less iodine than calculated using the iodine release upper-bound calculation model. In one case, the radiochemical iodine measurement was greater than the upper bound model. Remeasurement of this rod, 79-617, showed a decrease in the iodine concentration to a level well below the upper-bound calculation. The upper-bound iodine calculation method presented in the report is therefore corroborated by the radiochemical data.

- The presence of other volatile fission products on the cladding, cesium, and tellurium were confirmed by electron microprobe evaluation. The cesium concentration obtained from radiochemical data was on the cladding in greater concentration than iodine, as might be expected due to its higher fission product yield. Similarly, the failure to detect cadmium on the cladding during microprobe examination was probably due to its extremely small fission product yield.

C4.10 Corrosion and Hydriding of Irradiated Zircaloy Fuel Rod Cladding (Clayton 1982, WAPD-TM-1440)

Metallography and other destructive examinations were performed on some of the test samples. After collection of internal atmosphere gases, LWBR irradiation test fuel rods were sectioned to provide samples for measuring depletion, fluence, and hydrogen content and for metallographic evaluation. Metallographic samples were mounted in Hysol epoxy resin, which locked the fuel pieces in place and preserved the corrosion oxide for examination. Each piece was pressure-mounted by immersion in the epoxy resin pressurized to 1000 psi. A silicone rubber sleeve was used to isolate the outside cladding surface from the Hysol while it was immersed in Hysol for 24 hours at room temperature. The Hysol was cured for 2 hours at 200°F. The pressure-mounted pieces were sectioned with a diamond cutoff wheel to provide both transverse and longitudinal metallographic samples. More details about the sample preparation and the results are provided in Clayton 1982.

Nondestructive examinations of the rods consisted of visual examinations, dimensional measurements, gamma ray scanning, and neutron radiography; dimensional measurements consisted of measuring the overall length and diameter of the cladding; gamma ray scanning and neutron radiography were used to determine the condition of the internal rod components.

Irradiation histories of 47 LWBR test fuel rods 29 with RXA cladding and 18 with SRA cladding are given. The rod identification numbers of 25 of these rods, which are contained in the scrap canister, are given in Table C-14.

Table C-14. Rod identification numbers.

79-349	79-513	79-575	79-610	79-623
79-405	79-514	79-576	79-613	79-624
79-442	79-570	79-579	79-617	79-631
79-449	79-572	79-605	79-619	79-632
79-509	79-573	79-608	79-621	79-656

The results of the study are summarized below.

- CHORT predictions compare well with measured corrosion data from out-of-pile autoclave tests on LWBR Zircaloy-4 tubing.
- Corrosion thickness and hydrogen uptakes in LWBR irradiation test program fuel rod Zircaloy-4 cladding are less accurately accounted for by the CHORT program due in part to measurement scatter and material variability.
- Both out-of-pile and in-pile test data indicate that SRA Zircaloy-4 corrodes faster than RXA Zircaloy-4 does.
- Measured corrosion thickness of Maine Yankee, Kernkraftwerk Obrigheim, Turkey Point, and MELBA fuel rods are in reasonable agreement with CHORT predictions.

C4.11 Irradiation Performance of Duplex Fuel Pellet Test Rods Depleted to 9×10^{20} Fissions/cm^3 of Compartment—D-1 Test (Sphar, Mertz, and Roesener 1982, WAPD-TM-1460)

This report evaluated the irradiation performance of the D-1 test, which was a screening test of the duplex pellet prebreeder reactor fuel concept. The duplex pellet consisted of a cylindrical thoria pellet surrounded by an annulus containing urania enriched in U-235. The duplex pellet geometry offered the advantage of lower fuel temperatures than solid pellets for equal power output and provided a means of including the fertile material in the fuel rods with little or no loss of heat transfer surface while also providing a practical (chemical) means for separating the U-233 bred in the thoria central core without contamination by other uranium isotopes in the annulus. The test was conducted on duplex pellet annuli of four different compositions: UO_2, ZrO_2-UO_2, ZrO_2-UO_2-CaO and ThO_2-UO_2. Rods were irradiated, and destructive and nondestructive examinations were conducted.

The rod identification numbers of the rods used in the D-1 test are listed in Table C-15.

Table C-15. Rod identification numbers.

97-1	97-16	97-24	97-32	97-41
97-5	97-17	97-25	97-33	97-42
97-11	97-19	97-27	97-34	97-48D
97-12	97-20	97-28	97-36D	
97-13D	97-21	97-29	97-37	
97-14	97-22	97-30	97-39	
97-15	97-23	97-31	97-40	

The D-1 Test rods are 11 in. in length by 0.3 in. in diameter and consist of top and bottom Zircaloy-4 end- closures welded into seamless Zircaloy-4 cladding tubes. Cladding tube heat treatment is incorporated as a test variable. Rods were fabricated with recrystallization-annealed tubing or highly cold-worked stress-relief annealed tubes. Contained within the cladding tube are an 8-in. stack of fuel pellets and a 0.8-in. long plenum region containing an Inconel-X spring. Five different fuel stack arrangements were used for each of the duplex-annulus material type. These arrangements are designed to test various sizes and configurations of solid thoria spacers that maintain alignment of the duplex pellet components in the fuel stack. Each rod contains a solid cylindrical pellet, with about half the fuel loading of the duplex pellets, at each end of the duplex pellet stack. These pellets reduce power peaking at the ends of the pellet stack. Thoria pellets are incorporated on the outboard side of the power peaking suppressor pellets, against the bottom end closure and against the plenum spring; this is done to limit operating temperatures of the bottom end closures and the plenum spring. The four-annulus compositions tested in the D-1 rods are listed in Table C-16.

Table C-16. Compositions in the D-1 rods.

Annulus	UO_2 w/o	ZrO_2 w/o	CaO w/o	ThO_2 w/o	^{235}U Enrichment (%)
UO_2	22.3				22.3
ZrO_2-UO_2	34.0	66.0			97.7
ZrO_2-UO_2-CaO	36.9	58.1	5.0		97.7
ThO_2-UO_2	33.8			66.2	93.1

The UO_2 fuel was included because it is the fuel most commonly employed in commercial reactors. The ZrO_2 based fuels were included because they contain essentially no ^{238}U. Absence of ^{238}U results in a significant neutron economy advantage. Inclusion of the thoria based binary fuel extends the technology developed in the LWBR program for solid pellets with this fuel system to include the duplex pellet geometry.

Other D-1 test variables are: (1) magnitude of initial diametric clearance gap between the annuli and cladding and between the annuli and central pellets, (2) levels of rod internal prepressurization, and (3) defect operation.

Diametric clearance gaps between the annuli and cladding ranged from 45–84 mils, which is in the range of current commercial design practice. The gaps between annuli and the thoria central pellets were varied from 24–102 mils to investigate the effect of a wide range of this parameter on rod performance.

The principal advantages of prepressurization are: (1) increased margin to cladding collapse in the presence of an axial gap between fuel pellets and (2) decreased degradation of the thermal conductivity of the rod's internal atmosphere as fission gases are released from the fuel. Degradation in gap thermal conductivity is lessened by the increased concentration of higher conductivity helium as compared with released fission gases. In addition, there is reduced cladding "creep-down" due to the reduced pressure differential across the cladding which delays fuel-cladding interaction, reduces cladding strain, and reduces the potential for formation of fuel stack gaps. On the other hand, higher internal pressure reduces the loss-of-coolant accident performance capability with respect to an unpressurized rod. Therefore, it is desirable to optimize the initial pressure level within the rods. To study these effects, initial helium pressures of 100 and 500 psig at room temperature were selected.

Although not included in the original test, rods containing intentional defects in the cladding were introduced as replacement rods for the UO_2 and ThO_2-UO_2 rods terminated for destructive examination at an early stage. The intentional defects, included to investigate the behavior of rods with breached cladding, were in the form of 5-mil diameter holes drilled through the cladding at the approximate axial midplane of the rods.

The prime characteristics and variables of the individual D-1 test rods are given in the report.

C4.11.1 Fuel Components

Annuli—The outside chamfers at the pellet ends and the perpendicularity control were specified to minimize frictional forces between the fuel pellets and the cladding as the fuel stack lengthens and shortens with power changes. The chamfer eliminates sharp corners on the pellet while the limits on end face nonperpendicularity reduce pellet tilting tendencies and resulting radial forces of the pellet against the cladding. The chamfers also minimize the potential for creation of chips during rod loading. Chips, if present in the rod, may increase local strains in the cladding. The length-to-diameter ratio of the duplex-pellet annulus (2.1) is consistent with that of the LWBR seed pellets. The annulus wall thickness provides a nominal-annulus-to-central core cross sectional area ratio of unity that was considered acceptable with respect to manufacturing limitations and integrity during irradiation. With this 50/50 split, the volumetric heat generation rate and depletion of the annulus is about twice that of solid pellets producing equal power.

The annulus outside-diameters are sized to provide clearance gaps in the range of present commercial practice, which avoids premature fuel-cladding contact. Large radial gaps reduce heat transfer capability and increase fuel temperatures. Increases in fuel temperatures must be limited to avoid fuel structural changes or melting which can lead to cladding failure. The UO_2 rods and the ThO_2-UO_2 rods contain fuel-to-cladding diametric gaps in the range 49–85 mils. Because of poorer heat conduction properties, the Zirconia-based fuels have fuel-to-cladding gaps in the 45–58 mil range.

High density (>96% TD) was desired for all fuel materials to maximize thermal conductivity, thereby resulting in higher power production at the maximum allowable temperature of the fuel. In addition, high density minimizes fuel dimensional changes in service and consequent axial shrinkage of the fuel stack. Axial shrinkage in rods of commercial length might lead to collapse of unsupported cladding if axial gaps were to form between pellets.

The densities (derived from pellet dimensions and weights) of the annular fuel materials are as listed in Table C-17.

Table C-17. Density of annular fuel materials.

Fuel Material	Density (Percent TD)		
	Average	Maximum	Minimum
UO_2	95.1	96.5	93.1
ZrO_2-UO_2	92.4	93.1	91.6
ZrO_2-UO_2-CaO	94.0	95.0	93.3
ThO_2-UO_2	96.7	96.0	97.2

The fuel-to-cladding gap for the ZrO_2-UO_2 annular pellets was set about 1 mil below the gap sizes for the other fuel compositions to compensate for the lower density.

C4.11.1.1 Thoria Central Pellets. The thoria central pellets were prepared from available LWBR seed thoria pellets. The LWBR pellets, of about 98.8-percent TD, were nominally 0.256 in. OD and 0.530 in. long. The end dish depth and corner chamfers were 9 and 15 mils, respectively. Outside diameters of the thoria central pellets were ground to different sizes to obtain a range of annulus-to-central pellet diametric gaps. This was done as a test variable to evaluate the effect of central pellet eccentricity in the annulus on pellet temperatures and the effect of total clearance gap on fuel-cladding interaction. The length of the central cores was made less than that of the annuli to ensure that the annular pellets are longer than the central pellets at the highest predicted operating temperature and thus avoid axial gaps between the annuli.

C4.11.1.2 Thoria Spacers. Thoria spacers separating the duplex pellets may be necessary to maintain the axial alignment of the fuel stack. The effect of these spacers is investigated in the seven test rods of each fuel material by varying the length of the spacers (0.050, 0.100, and 0.530 in.) and the number of duplex pellets between spacers. The rods range from no spacers in the duplex pellet stack to having a spacer at each duplex pellet interface. These were prepared by slicing long pellets transversely and breaking the corners by tumbling in silicon carbide grit. The outside diameter of these thin spacers is nominally the same as the duplex pellets of the particular rod in which the spacers are located. The design of the 0.530-in. long spacer is the same as for the LWBR seed thoria pellets. The concave dish in each end of 0.530-in. spacer reduces the convex shape that would exist at power in a flat and ended pellet. Reduction of the convex contour minimizes axial expansion fuel-cladding interaction. The outside diameter of the long thoria spacers matches the outside diameter of the duplex pellets of the rod in which they are located.

C4.11.1.3 Thoria End Pellets. One long spacer was used at the bottom of the fuel stack in each rod to reduce operating temperatures at the end closure insert. The thin thoria spacers were used as required at the top of the fuel stacks to reduce operating temperature of the plenum spring and to achieve the desired overall fuel stack and plenum lengths in the rods.

C4.11.1.4 End Peak Suppressor Pellets. Power peaking is significant at the ends of the fuel stack of these short rods, which are in the high flux region of ends of the ATR. To limit this end peaking to acceptable values, ThO_2-UO_2 pellets with fissile loading about 40% of the annular pellets were positioned at the top and bottom of the fuel stack of each rod. The design of these flux suppressor pellets is the same as the long thoria pellets except that they are 0.58 in. long.

C4.11.2 Nonfuel Components

C4.11.2.1 End closures. The end closures, which were Tungsten Inert Gas welded into the cladding tube, were machined from Zircaloy-4 bar stock. The bottom end closure is designed to provide lateral, axial, and rotational restraint of the rod in the test holder while the top end closure provides lateral restraint but permits limited axial motion.

C4.11.2.2 Plenum Springs. The 0.785-in. long plenum region above the fuel stack contains an Inconel-X spring that provides a preirradiation axial load of 1.82 lb on the fuel stack. This force is about 12 times the fuel pellet stack weight and restrains the pellet stack from shifting during handling and shipment of the rods.

C4.11.2.3 Cladding. The Zircaloy-4 cladding for the D-1 test rods was fabricated by the Wolverine Tube Division of Universal Oil Products. Both RXA and SRA conditions were used; the properties are given in Table C-18. The outside diameter of the RXA tubing was decreased by about 4 mils to produce an outside diameter-to-thickness ratio (OD/t) of 13.9, which is representative of the LWBR seed rod design. The SRA tubing diameter was decreased by about 11 mils to produce an OD/t of 16.0, which is typical of commercial reactor practice. The outside diameters reductions were achieved by pickling in a mixture of hydrofluoric and nitric acids following fuel rod assembly.

Table C-18. Properties of tubing for D-1 test rods.

	RXA	SRA
As Fabricated outside Diameter (mil)	308±1	308±1
Inside Diameter (mil)	259±1	259±1
Wall Thickness (mil)	24.5	24.5
Final Heat Treatment (°F/hr)	1225/4	925/4
Cold-work, last of 3 Passes (%)	51	51
ASTM Grain Size	10	NA
Longitudinal Tensile Properties at 700°F		
0.2% Yield Stress (psi)	19,000	44,000
Ultimate-to-Yield Ratio	1.73	1.27
Total Elongation (%)	34	13
Contractile Strain Ratio	1.44	1.35
Chemistry (Billet Analysis)		
Hafnium (ppm)	23	23
Hydrogen (ppm)	4	4
Nickel (ppm)	30	30
Nitrogen (ppm)	30	30
Oxygen (ppm)	1300	1300

C4.11.3 Test Train Design

The in-pile hardware design used for the AWBA D-1 test was available from short rod tests in the LWBR Irradiation Testing Program. The D-1 rods are supported in the in-pile hardware by means of the end stems. The bottom, spade-shaped end stems of the rods are inserted through the bottom base plate. Flats on the portion of the end stem engaged by the base plate prevent rotation of the rods. A locking plate goes over the spade ends and slides laterally engaging the spade ends to prevent axial movement of the rods. The round, cone-tipped end stems at the top of the rods are inserted through mating holes in the upper locator plate. The distance between the bottom base plate and the top locator plate is 0.2 in. larger than the shoulder to shoulder length of the rods. This allows for free elongation of the rods by thermal expansion and axial clad strain. In the holder internals, the rods have the cross-sectional array. The rods are arranged on a square pitch of 0.355 in. with rod spacing of 0.052 in. The internal surface of the holder half shells are sculpted to represent the shape of additional rods, thus giving a flow pattern representative of a larger rod array.

The results of the study are summarized below.

C4.11.4 Nondestructive Examinations

C4.11.4.1 Rods Without Intentional Cladding Defects. Visual examinations of rods without intentional cladding defects resulted in no observations of irradiation-induced effects that raise concern over rod performance. Early stage corrosion in the form of isolated small white spots was observed on some rods at an early state of irradiation but did not appreciably worsen with irradiation.

Rod cladding dimensional measurements, overall length and diameters, in general indicate that fuel-cladding interaction has not yet become significant in the D-1 test rods.

At a fast neutron fluence of 25×10^{20} n/cm^2, the maximum reached by any of the rods, overall length strains were at most 0.24% for rods with SRA cladding and 0.12% for rods with RXA cladding; the strains are principally the result of stress-free zircaloy growth. The expected effects of rod internal prepressurization are evident in those rods with higher internal pressure that exhibit smaller length changes than rods with lower internal pressure.

Because of the lack of fuel-cladding interaction during the first half of test life, the diameter changes continued the trend of diameter shrinkage. Cladding heat treatment and thickness, level of rod internal BOL pressurization, and fast neutron fluence are the determining effects. The SRA clad rods with their thinner wall show greater diametric shrinkage than the RXA clad rods. Rods with higher fast neutron fluence show greater shrinkage. Furthermore, within the cladding material categories, the rods with lower BOL pressure show greater shrinkage due to the higher-pressure differential across the cladding.

Only one rod clearly shows onset of fuel-cladding interaction. Diameter traces for this rod reveal irregularities that correlate with the fuel stack components. Fuel-cladding contact was expected to occur first in this rod because of the unfavorable combination of characteristics, which included stress relief annealed cladding, low internal prepressurization, small-fuel-cladding clearance-gap, and high power rating.

Nondestructive examinations aimed at determining the condition of the internal rod components were gamma ray scanning and neutron radiography. The internal components of the rods did not have any abnormalities of intentional defects. Fuel stacks were shown to be in good condition with no evidence of pellet crushing or development of gaps between pellets. The various sizes and configurations of ThO_2 spacers performed satisfactorily.

The lengths of the fuel stacks in the D-1 rods were measured from the neutron radiographs and compared with the preirradiation fuel stack length changes. Observed changes ranged from -1.3 to +1.5%. Although data at depletions beyond $\sim 1 \times 10^{20}$ f/cc-compartment are limited, tentative trends in fuel stack behavior were observed which correlate with duplex-pellet annulus material. The UO_2 annulus rods showed small increases or decreases in stack length (-0.40 to +0.15%) at depletions $<1.5 \times 10^{20}$ f/cc-compartment. However, the one rod, which was radiographed a second time, at depletion of $\sim 6 \times 10^{20}$ f/cc-compartment had stack elongation of 0.39% following early-in-life shrinkage of 0.20%. This implies that following some early-in-life densification, fuel swelling becomes dominant.

Early-in-life fuel stack shrinkage was observed in the rods with ZrO_2-UO_2- CaO duplex pellets (ranging from 0.29%–0.45%) with no change during subsequent irradiation for the one rod radiographed again at depletion of $\sim 6 \times 10^{20}$ f/cc-compartment. Thus, it may be that in the ternary fuel swelling is less than for UO_2 and/or that densification is greater. The initial density, in terms of percent of theoretical, was lower for the ternary fuel (93.2% TD) than for the UO_2 fuel (95.5% TD).

Three rods with ThO_2-UO_2 duplex pellet annuli were subjected to neutron t radiography. Fuel stacks in all three elongated with a nearly linear growth rate of about 0.14% per 10^{20} f/cc-compartment.

The ThO_2-UO_2 rods had substantial shrinkage (up to 1.3%) at depletions above 2×10^{20} f/cc-compartment after initial increases; the increases are attributed to accumulation of small separations associated with the more extensive early-in-life cracking of the ZrO_2-UO_2 annuli as compared to the others. The subsequent shrinkage may be associated with lower in-pile creep-strength of the

ZrO_2-UO_2 material. Evidence of dimensional instability of the ZrO_2-UO_2 annuli was revealed by destructive examination of rod 97-22.

Based on these nondestructive examination results, it was concluded that performance of the duplex-pellet fuel system is quite good. Cladding and fuel pellet integrity was maintained, and dimensional changes were compared favorably with results of solid pellet tests previously conducted as part of the LWBR development program.

C4.11.4.2 Rods with Intentional Cladding Defects. Nondestructive examinations of rods with intentional cladding penetrations revealed several features of interest not observed on nondefected rods.

On the external cladding surfaces of rods with intentional cladding defects, flow patterns downstream from the intentional defect holes were observed. The most extensive flow pattern was observed on the rod that contained duplex pellets with UO_2 annuli. The one other defected rod irradiated for a long time contained ThO_2-UO_2 annulus duplex pellets and evidenced a flow pattern that was much less extensive than for the UO_2 rod. This indicates that the ThO_2-based fuel may be less susceptible to erosion and corrosion than the UO_2 fuel.

Circumferential white corrosion rings were observed on the cladding of the defected rod with ThO_2-UO_2 fuel at the locations of 50-mil thick thoria spacers separating duplex pellets in the fuel stack. Neutron radiography and preliminary metallographic examination of the cladding from this rod demonstrated that the white corrosion rings are associated with substantial nonuniform concentrations of hydrogen in the cladding; the regions affected by the corrosion rings coincided with the regions of heaviest hydrogen concentration. Preliminary destructive examination results also indicate that the primary source of the hydrogen was accelerated corrosion of the cladding inner surface during irradiation in the defected state. The fuel stack arrangement in this rod consists of pellets containing the fissile material (with high heat generation) interspersed with the ThO_2 spacers (with lower heat output) and generates hydrogen "cold traps" in the cladding.

The circumferential white corrosion rings on the cladding external surface, coincident with the regions of high hydrogen concentrations, are thought to be a result of the hydriding. Diameter measurements revealed ridging of the cladding at the locations of the corrosion rings; the average diametric ridge height was 0.8 mils with a maximum of 1.2 mils. This ridging was probably caused by the cladding-material volume increases associated with the extensive hydriding from internal cladding corrosion. Subsequent development of the external accelerated corrosion rings resulted from disturbances in the protective corrosion film due to local straining and/or perhaps reduced corrosion resistance of zirconium hydride. In the intentionally defected rod with UO_2 duplex pellets, irregularities in gamma ray intensity from a pellet near the defect hole were observed. Neutron radiography of this rod revealed the abnormality to be a fractured pellet with some rearrangement of the pellet fragments. The damage to the duplex pellet is believed to be the result of forces generated by the pressure buildup release through the defect hole during rod startup. The damage occurred during the first 30 days of irradiation and did not noticeably worsen during 118 days of additional irradiation.

These abnormalities are the result of defect operation and are not specifically related to the duplex pellet fuel design. The local high concentration of hydrogen in the cladding was caused by variations in cladding temperature associated with the alternating arrangement of fissile and fertile fuel pellets in the fuel stack. This problem can be solved by eliminating the thoria spacers and using other methods to maintain axial registry of the duplex pellet components. Fractured pellets near intentional defect holes have also been observed in previous LWBR tests with solid pellets.

C4.11.5 Destructive Examinations

Destructive examinations were not completed for nondefected rods and only started on the ThO_2-UO_2 rod with intentionally defected cladding.

Over the depletion ranges covered, fission gas release percentages were for all four fuel systems being investigated in the D-1 test and appeared to depend on fuel depletion more than on fuel material. The highest release measured is 1.75% for a ThO_2-UO_2 rod with depletion in the annulus material of 18.9×10^{20} f/cc. $U0_2$ and ZrO_2-UO_2-CaO rods with depletions of $\sim 12 \times 10^{20}$ f/cc had lower gas release, roughly in proportion to the annulus depletion.

Metallographic evaluations of the fuel components demonstrated that, macroscopically, all components appeared to be in good condition. Cracking of the duplex pellet components and the thoria spacers was observed, but geometrical integrity was maintained with no evidence of crushing or crumbling. No evidence was found for any of the fuel types of mass transport by evaporation of material from the high temperature (inside) surface of the duplex pellet annuli and condensation in colder regions of the rod.

The metallographic samples were analyzed using a Quantimet 720 Image Analyzing Computer to determine the total porosity and porosity-size distributions in the duplex pellet annuli. For all fuel material types, total porosity decreased during early irradiation. For the UO_2 fuel, continued irradiation to 13.0×10^{20} f/cc of annulus material resulted in continued reduction of porosity. For the ZrO_2-UO_2-CaO fuel, the existence of nonuniformly distributed large pores resulted in high variability of the Quantimet results and larger uncertainties in the porosity volume percents. However, disappearance of small-fabricated porosity early in life and emergence of very fine porosity believed to be fission gas bubbles with continued irradiation to 13.0×10^{20} f/cc of annulus material is evident. The ThO_2-UO_2 fuel, irradiated to the highest depletion (18.9×10^{20} f/cc of annulus material), also shows emergence of very small fission gas bubbles after initial disappearance of small pores; the translucency of the fuel and visibility of pores below the surface viewed complicates the pore volume analysis.

The dimensions of the duplex pellet components in the transverse metallographic samples were measured and, along with the fuel length changes derived from neutron radiography, were used to determine the effects of porosity changes and swelling effects on the fuel volume. For the UO_2 and ZrO_2-UO_2-CaO fuels, both at compartment depletions of $\sim 6 \times 10^{20}$ f/cc, decrease in the annulus volume is observed; whereas an increase in annulus volume is indicated for the ThO_2-UO_2 fuel at compartment depletion of 9.3×10^{20} f/cc. These volume changes correlate with the preirradiation densities of the pellets as shown in Table C-19.

Table C-19. Preirradiation density and volume change of fuel materials.

Fuel Material	Preirradiation Density (%TD)	Volume Change (%)
UO_2	95.5	-1.4
ZrO_2-UO_2-CaO	93.7	-4.7
ThO_2-UO_2	96.6	+1.2

For the UO_2 and ZrO_2-UO_2-CaO materials, no appreciable change in grain size from that of the unirradiated fuel was noted. For the ThO_2-UO_2 material, considerable difficulty was experienced in developing grain structure by chemical etching. Indistinct grain boundaries were revealed near the pellet outside diameter with size unchanged from the unirradiated size. Throughout the inner regions of the annuli, a finer microstructure without the angular shape characteristic of grains was observed. At the high depletion of this material, (18.9×10^{20} f/cc of fuel material) it appears that subdivision of grains, perhaps associated with high concentration of fission products, may be occurring. This phenomenon does not appear to have had any deleterious effects on fuel performance.

The microstructure of the ThO_2 components (central cores and spacer pellets) with maximum depletion of $\sim 0.5 \times 10^{20}$ f/cc-compartment is little different from the unirradiated material. Although there appears to be a decrease in the population of very small pores, larger pores, which constitute the bulk of the porosity, are essentially unchanged in number or size. Grain size also is unchanged from the preirradiation condition.

Investigations of the rod cladding to develop data relative to stress-corrosion cracking included:

- Metallography to assess cladding internal corrosion and fuel-cladding mechanical and chemical interaction.
- Visual examination of the inside surface of cladding.
- Examination of the inside surface of the cladding on the Scanning Electron Microscope. The cladding surface morphology of the irradiated cladding and of unirradiated cladding was studied.
- Electron Microprobe analysis of the irradiated cladding inside surface to determine the elements present and the local distribution of each.
- Chemical analysis to determine the total amount of iodine and cesium present on the cladding inside surface and inside the cladding material.
- Macroscopically, the metallographic evaluation of the cladding revealed no evidence of cracking or other defects.

Corrosion of the external cladding surface resulted in an oxide layer typically 0.04-0.08 mils (1–2 microns) thick. About 1/2 of this corrosion was present following preirradiation corrosion testing. On the internal surface of the cladding from the higher depletion rods with UO_2 and ThO_2-UO_2 fuel, localized patches (nodules) of corrosion, typically several microns thick and with maximum thickness of about 0.3 mil (10 microns), were observed. Visual examination of the cladding surfaces indicated these to be evenly distributed over the surface except at pellet interfaces where none were found. Electron microprobe analyses of the cladding from the UO_2 and ThO_2-UO_2 fueled rods indicate the corrosion nodules to be sites of concentration of uranium, thorium (if present in the fuel) and fission products. The coincidence of cladding corrosion nodules and fuel material/fission products implies a fuel transfer and fission enhancement mechanism for the formation of the corrosion. Simple rubbing of the fuel material on the cladding could be the cause.

This explanation is reinforced by observed differences in patterns of corrosion nodules on the cladding which correlate with different methods of fuel pellet grinding. The UO_2 fuel was centerless ground to diameter with the pellet simultaneously rotating and moving axially during the grinding. Corrosion nodules in the rod with UO_2 fuel were randomly distributed. The ThO_2-UO_2 fuel was plunge ground to diameter. In plunge grinding, the pellets do not move axially resulting in a series of minute ridges and grooves on the pellet surface. In the rod with ThO_2-UO_2, the corrosion nodules tended to be aligned in circumferential rows. Thus, it appears that fuel material transfer to the cladding occurred at points of fuel-cladding contact.

The cladding inner surface for the rod with ZrO_2-UO_2-CaO fuel was observed metallographically to have a continuous corrosion film about 0.3 mil rather than the patchy corrosion noted in the rods with the other fuel types. Visual examination of the interior cladding surface confirmed that the corrosion film covered essentially the entire surface; in addition the examination showed a mosaic-like appearance with individual parts of the mosaic roughly equal to the size of the fragments of the cracked annulus. Electron microprobe analysis of the cladding surface indicated spatially uniform concentrations of uranium, calcium and fission products. The causes of the differing appearance of the cladding associated with the ZrO_2-UO_2-CaO fuel as compared to the cladding associated with the UO_2 and ThO_2-UO_2 fuels is not well understood.

Corrosion nodules in the UO_2 and ThO_2-UO_2 fueled rods using replicas of the cladding surfaces observed visually with a Scanning Electron Microscopy ranged from <1 mil to ~3 mils in diameter. In areas not affected by the corrosion nodules, the surface appeared very similar to the unirradiated tubing. For the ZrO_2-UO_2-CaO rod, Electron microscopy shows a structure of very closely spaced corrosion patches.

Measurements were made of the quantities of iodine and cesium on the inside surface of cladding samples from rods of the different fuel types. The UO_2 and ZrO_2-UO_2-CaO fuel rods were at depletions of $\sim 6 \times 10^{20}$ f/cc-compartment and the ThO_2- UO_2 rod was at depletion of 9.3×10^{20} f/cc-compartment. Iodine and cesium on the surface were collected by means of a rinse with dilute nitric acid. The cladding sample was then dissolved to obtain iodine and cesium that had penetrated below the surface. Concentrations of these fission products found on and in the cladding, assuming uniform distribution, are shown in Table C-20.

Table C-20. Fission product concentrations on and in the cladding.

	Concentration (mg/dm^2)	
	Iodine	Cesium
UO_2 fueled rod 97-24	0.05	1.50
ZrO_2-UO_2-CaO fueled rod 97-39	0.05	0.85
ThO_2- UO_2 fueled rod 97-17	0.08	1.10

Microprobing of the cladding surfaces indicated that in the UO_2 and ThO_2- UO_2 rods, fission products were concentrated in corrosion nodules covering about 1/2 of the surface. Thus, local concentrations of iodine and cesium for the UO_2 and ThO_2-UO_2 rods might be about twice the values given in the above summary. In the ZrO_2-UO_2-CaO fueled rod, microprobing indicated uniform distribution of fission products.

The amounts of iodine found on or in the cladding of the three rods represent 0.26–0.31% of the amount of iodine calculated to have been generated in the fuel. These releases are a factor of 4–6 below the measured release of noble fission gases from the fuel. For cesium, the release percentages range from 0.16–0.34% and are a factor of 4–11 less than the percentage release of noble fission gases.

Based on the destructive examination results for nonintentionally defected D-1 test rods, it is concluded that performance capability of the duplex fuel system is excellent. For the range of depletion covered, fission gas release was low and fuel pellet integrity was maintained with minimal dimensional changes. No effects of irradiation beyond expectations were observed.

C4.12 Irradiation Performance of Long Rod Duplex Fuel Pellet Bundle Test—LDR Test

(Waldman, Sphar, and Alff 1982, WAPD-TM-1481)

This test was conducted to investigate the performance characteristics of a long column of duplex fuel, interacting with the cladding, as distinguished from earlier tests of very short lengths of duplex fuel. The test was designated The Long Duplex Rod (LDR) Test. Six rods were used for the test (97-52, 97-53, 97-54, 97-55D, 97-57, and 97-58), all are contained in the scrap canister. The rods contained duplex-fuel stacks about 67 in. in length and were operated in a test reactor with a 48-in. fuel height; this resulted in an irradiated fuel length of about 63 in. The LDR Bundle Test was irradiated in the north and southeast test loops of the ATR; these loops provided separate pressure, flow, and heat removal systems, independent of those of the ATR facility; the ATR provided the neutron environment.

Individual fuel rod characteristics are listed in the report. All the fuel rods had fuel cladding diametric gaps in the range 4.4–8.8 mils; they were operated at relatively high power levels, characterized near BOL in the range 14-16.9 kW/ft, and to high depletions, the highest being 14.2×10^{20} f/cc of compartment (28.0×10^{20} f/cc of fuel annulus volume) during normal testing. At the end of normal testing, five rods were irradiated at a power level higher than in the preceding cycle, for a period of about 27 days. Four rods experienced an increase in power in the range 40–49% and one rod 19%. None of the rods failed. All dimensional data given in the report were obtained prior to the EOL high power cycle. Properties of the cladding are the same as those given for the D-1 tests given above.

Significant variables included in the test were the following:

- Three different fuel compositions were tested as the annular portion of the duplex fuel. These compositions were UO_2, ZrO_2-UO_2-CaO, and ThO_2-UO_2 respectively. In all cases, the central core pellet was ThO_2.
- The duplex fuel was stacked with and without periodic full-diameter ThO_2 spacer pellets. Spacer pellets were intended to maintain axial registry between the annulus and the core.
- Both SRA and RXA zircaloy cladding were used.
- Rod internal prepressurization levels of 100 and 500 psig at room temperature were established.
- In addition, one intentionally defected rod was tested.

Based on the resulting data, the following summary observations have been made:

Compared with fuel rods with RXA cladding, fuel rods with SRA cladding experienced greater elongation and more cladding diametric shrinkage in regions where pellet-cladding interaction (PCI) was absent.

Fuel rods prepressurized to 500 psig experienced less cladding elongation and less cladding shrinkage than fuel rods prepressurized to 100 psig, within each group of the two cladding types.

No differences in performance characteristics could be assigned to any of the three fuel compositions. As evidenced by rod diameter change, the largest amount of PCI occurred with the rod having ThO_2-UO_2 fuel. This observation has no special significance, however, because this rod operated at the highest power and to the highest depletion.

No appreciable PCI occurred in rods with RXA cladding at intermediate peak depletions of 6.0×10^{20} and 7.9×10^{20} f/cc of compartment or at a high depletion of 11×10^{20} f/cc of compartment. This determination was made from axial diameter profiles.

Measurable PCI occurred in fuel rods with SRA cladding at high-peak compartment depletions of 11.7×10^{20} and 14.2×10^{20} f/cc compartment.

Of the two fuel rods which experienced the largest length change (rods with SRA cladding), the rod with the most pellet-cladding interaction, as indicated by axial diameter traces, did not show the largest length increase. The reason for this behavior may be related to two possible mechanisms acting separately or in concert; namely, (1) radial expansion of cladding would be expected to be reflected in a corresponding axial shrinkage and (2) a decrease in axial ratcheting could occur due to local locking and compartmentalization of fuel within the cladding. The latter mechanism may be enhanced by the presence of spacer pellets.

Neutron radiography showed a fuel stack length increase of 0.18% at a low peak compartment depletion of 1.1×10^{20} f/cc, indicating little or no densification in the high density, high fission rate UO_2 annular fuel.

Neutron radiographs of one fuel rod at a peak compartment depletion of 7.9×10^{20} f/cc, and a second rod at a peak compartment depletion of 11.7×10^{20} f/cc indicate no loss in the mechanical integrity of the annular fuel column; i.e., no fragmentation of the annuli. Fuel stack growth of about 0.5% was observed for these rods.

The neutron radiograph of one fuel rod identified a 0.14-in. gap in the central-core thoria-pellet stack in the upper portion of the rod, and a gap of 0.52 in. between the top of the central-core thoria-pellet stack and the top of the annular fuel stack. Based on these observations, the annular fuel stack was 0.66 in. longer than an uninterrupted central core stack. This rod was fabricated with no thoria spacer pellets and a central thoria core length 0.2 in. less than the annular fuel length to form an intentional axial gap. Comparison with an X-ray of the as-built rod revealed that the annular fuel stack had grown 0.37 in., and the central-core thoria-stack had contracted 0.09 in.

A comparison was made of cladding elongation between two groups of rods, both had SRA cladding and one operated with solid ThO_2-UO_2 pellets; the other was the LDR test with UO_2 and ThO_2-UO_2 duplex pellets. These rods all operated with similar power and fuel cladding gaps. Based on the data, less PCI-induced length change occurs with duplex fuel.

Based on fuel rod-to-fuel rod gap measurements, no significant fuel rod bowing occurred over the life of the test.

The intentionally defected rod was fabricated with a 5-mil diameter hole but experienced a water logging event that increased the diameter of the unirradiated portion of the rod; this reached a stress level near yield and caused an apparent flux-induced creep bulging in the power region.

The intentionally defected rod, which had ThO_2 spacer pellets between adjacent duplex pellets, developed hydride rims and subsequent accelerated corrosion on the external surface of the cladding at the locations of the spacer pellets. These hydride rims were revealed in axial diameter traces and in neutron radiographs showing a typical hydride color contrast in cladding over thoria spacers. These hydride rims could result in cladding embrittlement and reduced load carrying capacity.

It is concluded that this program demonstrated satisfactory performance of the test bundle and of fuel rods containing duplex fuel pellets, which were irradiated to high fuel-annulus depletion and through a severe transient.

C4.13 Experimental Results of the Irradiation of Long Rod Duplex Pellet Screening Tests in the NRX Reactor, New Long Duplex Rod (NLDR) Test
(Hoffman, Yerman and Alff 1982, WAPD-TM-1492)

One of the designs developed by the AWBA program for a commercial-scale, prebreeder reactor core was based upon the use of fuel rods containing duplex pellets. A duplex pellet consists of a cylindrical thoria central pellet within an oxide annulus that contains fissile material. During irradiation, ^{232}Th in the central pellet is converted to ^{233}U for subsequent use in a breeder reactor core. If a UO_2 annulus is used, it can be chemically separated from the thoria central pellet following irradiation so that the ^{233}U in the central pellet is kept free of contamination by other uranium isotopes. Freedom from contamination could also be achieved by use of separate fissile and fertile fuel rods. However, reactor core power densities comparable to those of commercial cores cannot be achieved when the thorium fraction in a separate fuel rod core is high enough for efficient production of ^{233}U.

There are also a number of advantages of duplex pellets over solid pellets in both breeders and commercial reactor core applications. These advantages result mainly from the low operating fuel temperature. An irradiation test program was undertaken at Bettis to support development of duplex-pellet fuel rods. The New Long Duplex Rod (NLDR) test series (designated NLDR-1, NLDR-2, NLDR-3, and NLDR-4) was one part of this irradiation test program. The NLDR tests used six 110-in.-long, 0.3-in.-diameter Zircaloy-4 clad rods containing duplex pellets. The principal design variables are given in Table C-21. The NLDR test series was accomplished in the NRX reactor at the Chalk River Nuclear Laboratory in Chalk River, Ontario, Canada.

Table C-21. Principal design variables.

Rod ID	Test	Annular Pellet Composition	Fuel Cladding Gap (mils)	Special Features	Total Irradiation Time, EFPH
97-61	NLBR-1	UO_2-ZrO_2-CaO	55	None	11,149
97-62	NLBR-1	UO_2	55	None	11,149
97-64	NLBR-2	ThO_2-UO_2	55	None	10,281
97-65	NLBR-2	UO_2	36	None	6,340
97-123	NLBR-3	UO_2	36	2 plenum springs	8,056
97-162	NLBR-4	UO_2	43	Longer central pellets	4,115

The test series was conducted to:

- Evaluate the behavior of duplex fuel pellets in long rods with pellet-cladding interaction axial loads similar to those that would be experienced by fuel rods in commercial service
- Compare the performance of UO_2 and UO_2-ZrO_2-CaO duplex pellet fuel systems at power levels adjusted to reflect relative melting points
- Compare the performance UO_2 duplex fuel with a smaller cladding gap
- Compare the performance of fuel rod containing two plenum springs with fuel that has one spring
- Assess the effect of longer central thoria pellets on rod behavior.

The conclusions drawn from the testing are as follows:

- All fuel rods experienced relatively small overall external dimensional changes with irradiation up to 17.8×10^{20} f/cc compartment (about 35.6×10^{20} f/cc annulus).
- The UO_2 rod (97-64) experienced earlier fuel-cladding interaction and greater cladding length increases than the UO_2-ZrO_2-CaO rod (97-61) irradiated under the same conditions.
- Beyond about $12–13 \times 10^{20}$ f/cc peak depletion, both rods experienced cladding length decreases. This phenomenon had not been previously observed in Bettis long rod tests of solid ThO_2-UO_2 fuel pellets irradiated in the LWBR program.
- Large gap ThO_2-UO_2 rod (97-64) exhibited overall length increase less than those of the large gap UO_2 rod (97-62) but greater than those noted for the large gap UO_2-ZrO_2-CaO rod (97-61).
- Small gap UO_2 rod (97-65) experienced greater length increases and an earlier "turn around" in length change than large gap UO_2 rod (97-62).
- At comparable depletions, small gap UO_2 rod (97-123) with two plenum springs experienced less length increase than any other UO_2 rod in the test; some of this difference is attributed to operation at only 75–80% of design power for about 1/3 of the lifetime.
- UO_2 rod (97-162) with long central pellets experienced a greater initial length increase than any other NLDR test rod but its behavior at intermediate depletions was typical of the other UO_2 rods in the test.
- Closure of both the fuel-to-cladding and annulus-to-central pellet gaps resulted in significant cladding diameter increases due to continued radial swelling of the fuel. This phenomenon was observed in all three fuel systems.

C4.14 In-Pile and Out-of-Pile Corrosion Behavior of Thoria-Urania Pellets
(Clayton 1987a, WAPD-TM-1548)

A total of 19 LWBR irradiation test rods from 14 irradiation tests (summarized in the report) composed the database for the in-pile portion of the fuel stability study. Nine of the rods are contained in the scrap canister (79-301D, 79-307D, 79-322D, 79-433D, 79-441D, 79-504D, 79-583D, 79-609D, and 79-614D). The 19 fuel rods contained ThO_2, $ThO_2/^{235}UO_2$, and $ThO_2/^{233}UO2$ fuel pellets. The rods (14 seed and 5 blanket) were intentionally defected with drilled holes prior to testing. A larger (~0.089-cm diameter) spotting hole was first drilled halfway through the Zircaloy-4 cladding from the outside surface and then continued through the wall to the inside surface with a smaller 5-mil diameter (~0.013-cm diameter) defect hole. Irradiation histories of the 19 defected rods are given; irradiation exposures were up to 19,970 EFPH with peak fluences (>l Mev) of up to 98×10^{20} n/cm^2. The coolant for these irradiation tests was pressurized water maintained at pH 10 by NH_4OH addition. Coolant oxygen, hydrogen, and chlorine concentrations were <0.14 ppm, 40-70 cc/kg, and <0.1 ppm, respectively. The irradiation tests were performed in the ETR, the ATR and the NRX. A summary of the in-pile testing results follows.

- Satisfactory fuel performance was demonstrated in the ThO_2 and ThO_2-UO_2 fueled defected LWBR test rods irradiated to peak depletions up to 12×10^{20} f/cc and peak fast neutron (>l Mev) fluences up to 98×10^{20} neutron/cm^2.

- Excellent fuel chemical, mechanical, and thermal behavior was shown for operating conditions up to peak linear power levels of 518 w/cm, peak heat fluxes up to 189 w/cm^2, and peak center temperatures up to 2366K.

- No evidence of significant corrosion or erosion of the fuel pellets was observed. Nine of the 19 intentionally defected rods displayed some minor indications of corrosion-erosion; white or gray streaks or spots manifested this just around or downstream from the defect hole openings. These effects were only observed in the area around the defect and were most likely the result of a limited amount of fuel, fission product, or contaminated zircaloy corrosion locally downstream of the hole.

- No other indications of fuel corrosion-erosion were detected. The ThO_2 and ThO_2-UO_2 fuel pellets, when compared with previous in-pile tests on UO_2 and ZrO_2-UO_2 fuels, had lower levels of released activity, slower fission product leaching, and minimal fuel solution and attrition by the coolant.

No fuel grain growth was detected but there was some migration of porosity to the grain boundaries. Fuel cracking occurred as would be expected for long-term operation of both defected and nondefected fuel rods. No evidence of fuel waterlogging was observed. (Waterlogging is deformation of the cladding caused by excessive internal fuel rod pressure of entrapped coolant as it flashes to steam during a power increase).

The conclusions drawn from the testing are as follows:

- Both ThO_2 and homogeneous ThO_2-UO_2 (2-30 w/o UO_2) fuel pellets have excellent corrosion resistance - even in oxygenated, high temperature, pressurized water.

- Thoria-urania is one of the most corrosion resistant of all UO_2 solid solution oxide fuels. Even when oxidative attack does occur, the mode of oxidation, growth of a second cubic phase, permits the ThO_2-UO_2 samples to maintain their integrity.

- Maintenance of fuel integrity in defected irradiation test rods was consistent with the favorable stability of out-of-pile corrosion tests on thoria-base fuel pellets.

- Under the defect condition of exposure to high temperature water containing an oxidant (H_2O_2 or O_2 from fission fragment radiolysis of the water coolant), thoria-base fuels exhibit: (1) slower fission product leaching, (2) lower levels of released activity, and (3) slower fuel solution and attrition by the coolant than is the case for UO_2 and ZrO_2-UO_2 fuel systems.

- Both the in-pile and out-of-pile test results support the conclusion that LWBR-type fuel rods containing ThO_2 and ThO_2-UO_2 pellets can successfully operate in the defect condition with limited radioactivity release to the coolant.

C4.15 Internal Hydriding in Irradiated Defected Zircaloy Fuel Rods—A Review
(Clayton 1987b, WAPD-TM-1604)

The review summarizes the test data, causes, mechanism, and methods of minimizing internal hydriding failures in defected zircaloy-clad fuel rods. A defect is defined as a breach of cladding integrity, i.e., a perforation (slit. crock. or pinhole) that leaks fission products to the coolant and coolant to the rod internals. Many defected zircaloy-clad fuel rods operated satisfactorily without diminishing core performance. A fuel rod failure is defined as loss of cladding integrity, high coolant activity level, and contamination of the coolant by particulate fuel.

Two types of hydriding, external hydriding produced by hydrogen outside the fuel rod and internal hydriding due to reactions inside the fuel rod, were identified in zircaloy-clad fuel rods. Internal hydriding is further classified as primary or secondary hydriding. Primary hydriding is generated internally in an initially nondefected zircaloy fuel rod. Its sources are hydrogenous contaminants (moisture, oil, grease, etc.) introduced into the fuel rod during fabrication as well as any residual hydrogen in the oxide fuel resulting from the hydrogen sintering operation. In secondary hydriding the initial breach of the zircaloy cladding is caused either by primary hydriding itself or by a nonhydride-related incident that allows coolant to enter and hydride the rod. Examples of a nonhydriding incident include stress-corrosion cracking induced by pellet-cladding interaction, power ramp, aggressive fission product attack, rod-to-rod contact causing high cladding temperatures, cladding wear at support grid contact points, etc. The report reviewed the problem of secondary hydriding, mainly in pressurized water reactors where the coolant contains some dissolved hydrogen.

Hydrogen pickup in zircaloy fuel rods falls into three categories: expected due to corrosion, accelerated, and massive. Expected hydrogen pickup results from the additional hydrogen that enters the zircaloy cladding through the ZrO_2 corrosion film (about 50–500 ppm). Accelerated hydriding is defined as hydrogen absorption from the coolant far in excess of the nominal 25% pickup fraction of free H_2 produced by the Zr-H_2O corrosion reaction for Zircaloy-4 (several thousand ppm). Massive hydriding is the formation of regions of delta phase zirconium hydride in the cladding due to grossly accelerated hydrogen pickup (16,300 ppm). At operating temperatures for PWRs, zirconium is thermodynamically unstable with respect to hydrogen and should completely hydride. The protective corrosion oxide surface film prevents the gaseous hydrogen in the coolant from reacting with the bare zircaloy.

As part of the review intentionally defected rods from pre-LWBR tests, the LWBR (19 fuel rods—identification numbers of the rods in the scrap canister are given above), and the AWBA programs (3 fuel rods—97-36D is in the scrap canister) were analyzed.

C4.15.1 Pre-LWBR Tests

The Bettis Laboratory was one of the first to study the behavior of defected zircaloy-clad UO_2 fuel rods in-pile and the factors affecting the limit of their performance. The initial work was carried out in the 1950s in support of the Shippingport PWR Core I blanket rods. Excessive cladding hydriding was observed in both intentionally defected rods and in rods that operationally defected in-pile (unintentionally defected). Hydrogen contents of 100–200 ppm were found in cladding near defects and 1400 ppm at the ends of the rods. Either the intentionally fabricated defect holes of some rods became plugged or the areas of the rod away from the defect hole became effectively isolated and behaved as though the rods were not defected. In any case, the cladding of these rods became stressed and ruptured during irradiation with resultant hydriding.

Since 1960, massive internal hydriding was found only in rods that operationally defected in-pile. Sixteen such in-pile defected rods were observed. Fuel compositions were mainly UO_2, ZrO_2-UO_2 and UO_2-ZrO_2-CaO. Irradiation periods in the defected state after cladding rupture varied from about five minutes to approximately 200 days. Cladding cracking, both ductile and brittle, was attributed to bad welds, burnout caused by molten fuel, cladding instability due to fuel swelling, and water logging. All 16 rods were destructively examined, and extensive areas of massive internal hydride were detected in 13 of them. Both accelerated and massive hydriding occurred at remote locations from the defect. Two of the remaining rods were found to have brittle cladding fractures. Hydride-was observed mainly in the cladding near the end caps. The cladding over the fuel stacks was relatively free of hydride. The last rod waterlogged and displayed only an overall high hydrogen content in the cladding (about 300 ppm) but did not exhibit massive hydriding.

Thirty intentionally fabricated defected rods were tested between 1960–1970. These rods were fabricated with various pellet geometries (annular, dished-end, solid), pellet densities (84–98% theoretical), and fuel materials (UO_2, ZrO_2-UO_2, ThO_2-UO_2). The irradiation performance of these intentionally defected rods was satisfactory. Postirradiation fuel structures ranged from that of the preirradiation structures to almost total fuel melting.

Three cases of water logging occurred in these intentionally fabricated defected rods. Cladding diameter swelling was measured in a UO_2-fuel and a ZrO_2-UO_2 fuel rod. Another ZrO_2-UO_2 fuel rod ruptured resulting in cladding hydrogen concentrations of about 500 ppm, but massive internal hydriding was not found. This failure was attributed to excessive plastic straining caused by repeated water logging incidents during irradiation. With the exception of the ruptured rod, there were no detectable fuel losses associated with the irradiation of these 30 intentionally defected fuel rods.

Six of these intentionally defected rods contained ThO_2-UO_2 fuel. There were no unusual incidents during the irradiation of these rods indicating satisfactory performance.

The pre-LWBR test data can be summarized as follows:

- Fuel rods with intentionally fabricated defects generally did not excessively hydride.
- Fuel rods that defected in-pile generally had areas of accelerated or massive hydriding.

C4.15.2 LWBR Tests

The Shippingport LWBR core contained 12 hexagonal-shaped modules that were arranged in a symmetric array surrounded by 15 reflector modules. Each of the hexagonal fuel modules contained a central movable seed assembly surrounded by a stationary blanket assembly. The fuel was ThO_2 and

ThO_2-UO_2 pellets that were sealed in Zircaloy-4 tubes. The absence of higher-than-expected coolant activity during operation indicated that there was no detectable breach of the cladding in any of the LWBR rods.

As part of the LWBR irradiation test program, 19 fuel rods (14 seed and 5 blanket) were intentionally defected with drilled holes (0.005-in. diameter) prior to testing. In addition, two blanket test rods developed small cladding defects during planned in-service transient testing. The transient testing was at higher heating rates than occurred during LWBR reactor operations.

All 21 defected test rods operated successfully with limited radioactivity release to the coolant. No significant ThO_2 or ThO_2-UO_2 fuel erosion was detected. Because of the greater internal surface corrosion, the total hydrogen content in the defected rod cladding was several times those in nondefected rod cladding with similar irradiation histories 100–500 ppm compared to 30–70 ppm hydrogen. A pronounced variation in hydride concentration was observed through the cladding wall thickness of the defected rods. Hydrogen levels in the cladding were higher at the external surface than at the internal surface because hydrogen diffuses toward the cooler region in a sufficiently high thermal gradient. The hydride concentrations for nondefected rod cladding were relatively uniform.

Hydrides in the vicinity of the defect hole were generally low in concentration with typical uniform levels of about 100 ppm. This might occur from hydrogen escaping through the defect hole resulting in a low H_2/H_2O ratio or hydrogen diffusion to adjacent cooler cladding areas. Evidence of hydrogen migration to cooler regions of the rods remote from the defect hole was observed, indicating that local hydrogen levels are not always proportional to corrosion oxide thickness in defected rods.

Instances of localized accelerated and massive hydriding were detected in three intentionally defected and one operationally defected fuel rod. None of these incidents interfered with the operation of the irradiation tests. For example, one rod that defected in service due to iodine stress corrosion cracking operated successfully for about 12,000 EFPH. This rod was operational even though during postirradiation examination the cladding was observed to be massively hydrided near the bottom end of the rod. None of these hydrided rods lost structural integrity during operation, which attests to their ability to function under localized and massive hydriding conditions.

C4.15.3 AWBA Tests

The AWBA program used a duplex pellet concept. The duplex pellet design consisted of a cylindrical thoria central core inside an oxide annulus that contained the initial fissile material. Transmutation of the thorium in the duplex pellet to ^{233}U provides fuel for use in subsequent breeders. The irradiation test program supporting development of the duplex fuel pellet included three intentionally fabricated defected rods, two with UO_2 and one with ThO_2-UO_2 annuli.

Some slight erosion was noted in the UO_2 fueled defected rod. The irradiation performance of the ThO_2-UO_2 fueled defected rod compared favorably with that of the LWBR solid ThO_2-UO_2 pellet irradiation tests. Circumferential white corrosion rings were observed on the outside cladding surface of the defected rod with the ThO_2-UO_2 annulus at the locations of 50-mil-thick ThO_2 spacers separating the duplex pellets in the fuel stack. Neutron radiography and metallographic examination of the cladding showed that the white corrosion rings were associated with substantial nonuniform concentrations of hydrogen in the cladding, with the regions affected by the corrosion rings coinciding with the regions of heaviest hydrogen concentration. In regions of cladding adjacent to the ThO_2-UO_2 annulus, hydrogen concentrations ranged from <100 ppm near the inner surface to several hundred ppm or more near the outer surface. In the cooler cladding adjacent to ThO_2 spacer pellets, much higher concentrations of hydrogen were observed. These concentrations varied from about 500 ppm near the inner surface to approximately 12,000 ppm in a rim about 3 to 5 mils thick at the outer surface. The fuel stack arrangement in this rod, consisting of pellets containing the fissile material (with high power and heat generation) interspersed with the ThO_2 spacers (with lower power and heat output), generated hydrogen cold traps in the cladding.

Diameter measurements revealed ridging of the cladding at the locations of the white corrosion rings. The average diametric ridge height was 0.8 mil with a maximum of 1.2 mils. This ridging could be caused by the volumetric increases associated with the extensive hydriding. Subsequent development of the accelerated white corrosion rings then resulted from disturbances in the protective corrosion film due to local straining and/or reduced corrosion resistance of zirconium hydride.

A summary of the review follows:

- Intentionally defected zircaloy test rods usually do not excessively hydride.
- Zircaloy fuel rods that defect in service generally acquire localized areas of accelerated or massive hydride.
- Both intentionally and operationally defected fuel rods with local areas of accelerated and massive zirconium hydride can operate without failure for extended periods of time under restricted power conditions.
- Out-of-pile zirconium hydriding test data in H_2/H_2O gas mixtures shows that specimen characteristics (geometry and surface conditions) as well as environmental factors (hydrogen pressure, test temperature. and test time) affect the amount of hydrogen pickup in zircaloy. In addition, the type of zircaloy (2 or 4), the heat treatment, and minor variations in the alloying conditions were also found to influence hydrogen absorption.
- The significant factors affecting internal hydriding in defected zircaloy rods are defect size, sources of hydrogen, zircaloy cladding inside surface properties, aggressive fission product attack on inner oxide film, nickel alloy contamination of zircaloy, and the effects of heat flux and fluence.
- Pertinent in-pile and out-of-pile test data and the significant factors affecting internal hydriding in defected zircaloy fuel rods are used as a data base in constructing a descriptive model which explains hydrogen distribution in zircaloy cladding of defected water-cooled reactor fuel rods.
- Methods for minimizing secondary hydride failures in defected zircaloy fuel rods include control of hydride orientation, protective coatings, hydrogen getters, and power operating restrictions.

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Appendix D

Rods in the Type C Storage Liners

Appendix D

Rods in the Type C Storage Liners

The rod serial numbers and end-of-life isotopic contents are presented below, sorted first by liner number then by liner cell. The liner cell numbers correspond to Figures 6-17 through 6-23. The first two digits of the rod serial numbers for the seed and blanket rods indicate the rod type.

The data in the tables are end-of-life isotopic data based on modeling done before the time of shipment. These data were extracted from tables attached to the Part B Fuel Receipt Criteria for the Type C (loose rod) storage liners. These data are presented here for convenience. Refer to the original documentation to confirm the accuracy of transcription.

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
101	3120818	15681	L-RA01-10	R 4-3	43	6.09	0.00	4.54	0.03	0.00	0.00	0.00	4.56
102	3116829	15681	L-RA01-10	R 4-3	47	6.04	0.04	30.97	1.12	0.09	0.00	0.00	32.23
103	3225352	15681	L-RA01-10	R 4-3	44	6.09	0.00	9.36	0.10	0.00	0.00	0.00	9.47
104	3214013	15681	L-RA01-10	R 4-3	45	6.08	0.01	15.31	0.28	0.01	0.00	0.00	15.61
105	3206266	15681	L-RA01-10	R 4-3	46	6.08	0.02	22.42	0.59	0.04	0.00	0.00	23.06
144	3116443	15681	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
145	3122403	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
146	3116508	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
147	3116755	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
148	3124547	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
149	3121009	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
150	3215104	15681	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
151	3224665	15681	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
152	3202216	15681	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
153	3203233	15681	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
154	3202243	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
155	3200346	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
156	3207568	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
157	3207357	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
158	3116553	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
159	3118000	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
160	3107486	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
161	3117377	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
162	3116865	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
163	3123401	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
164	3104572	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
165	3207027	15681	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
166	3204680	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
167	3204764	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
168	3205507	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
169	3220265	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
170	3206578	15681	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
171	3206367	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
172	3214884	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
173	3216873	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
174	3108779	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
175	3107203	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
176	3102419	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
177	3122834	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
178	3118880	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
179	3122356	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
180	3217322	15681	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
181	3101815	15681	L-RA01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
182	3102354	15681	L-RA01-08	R 5-4	49	6.09	0.00	10.46	0.12	0.00	0.00	0.00	10.59
183	3210127	15681	L-RA01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
184	3125500	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
185	3121615	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
186	3222768	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
187	3220650	15681	L-RA01-03	R 4-9	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
188	3202032	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
189	3126177	15681	L-RA01-03	R 4-9	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
190	3122521	15681	L-RA01-03	R 4-9	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
191	3126186	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
601	3224023	15681	L-RA01-10	R 4-3	43	6.09	0.00	4.54	0.03	0.00	0.00	0.00	4.56
602	3214250	15681	L-RA01-10	R 4-3	43	6.09	0.00	4.54	0.03	0.00	0.00	0.00	4.56
603	3225085	15681	L-RA01-10	R 4-3	44	6.09	0.00	9.36	0.10	0.00	0.00	0.00	9.47
604	3222566	15681	L-RA01-10	R 4-3	43	6.09	0.00	4.54	0.03	0.00	0.00	0.00	4.56
605	3102015	15681	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
606	3105315	15681	L-RB01-08	R 5-4	49	6.09	0.00	10.46	0.12	0.00	0.00	0.00	10.59
607	3105167	15681	L-RB01-08	R 5-4	49	6.09	0.00	10.46	0.12	0.00	0.00	0.00	10.59
609	3113336	15681	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
610	3122879	15681	L-RA01-10	R 4-3	46	6.08	0.02	22.42	0.59	0.04	0.00	0.00	23.06
611	3114326	15681	L-RA01-10	R 4-3	47	6.04	0.04	30.97	1.12	0.09	0.00	0.00	32.23
612	3114804	15681	L-RA01-10	R 4-3	46	6.08	0.02	22.42	0.59	0.04	0.00	0.00	23.06
613	3111504	15681	L-RA01-10	R 4-3	45	6.08	0.01	15.31	0.28	0.01	0.00	0.00	15.61
614	3112815	15681	L-RA01-10	R 4-3	45	6.08	0.01	15.31	0.28	0.01	0.00	0.00	15.61
615	3120156	15681	L-RA01-10	R 4-3	45	6.08	0.01	15.31	0.28	0.01	0.00	0.00	15.61
616	3223188	15681	L-RA01-10	R 4-3	44	6.09	0.00	9.36	0.10	0.00	0.00	0.00	9.47
617	3213858	15681	L-RA01-10	R 4-3	44	6.09	0.00	9.36	0.10	0.00	0.00	0.00	9.47
618	3201776	15681	L-RA01-10	R 4-3	45	6.08	0.01	15.31	0.28	0.01	0.00	0.00	15.61
619	3211429	15681	L-RA01-10	R 4-3	45	6.08	0.01	15.31	0.28	0.01	0.00	0.00	15.61
620	3126022	15681	L-RA01-10	R 4-3	47	6.04	0.04	30.97	1.12	0.09	0.00	0.00	32.23
621	3126159	15681	L-RA01-10	R 4-3	43	6.09	0.00	4.54	0.03	0.00	0.00	0.00	4.56
622	3211034	15681	L-RA01-10	R 4-3	45	6.08	0.01	15.31	0.28	0.01	0.00	0.00	15.61
623	3208834	15681	L-RA01-10	R 4-3	46	6.08	0.02	22.42	0.59	0.04	0.00	0.00	23.06
624	3117709	15681	L-RA01-10	R 4-3	44	6.09	0.00	9.36	0.10	0.00	0.00	0.00	9.47
625	3115580	15681	L-RA01-10	R 4-3	44	6.09	0.00	9.36	0.10	0.00	0.00	0.00	9.47
626	3117560	15681	L-RA01-10	R 4-3	43	6.09	0.00	4.54	0.03	0.00	0.00	0.00	4.56

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
627	3102583	15681	L-RA01-10	R 4-3	43	6.09	0.00	4.54	0.03	0.00	0.00	0.00	4.56
628	3122513	15681	L-RA01-03	R 4-9	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
629	3120165	15681	L-RA01-03	R 4-9	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
630	3104417	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
631	3121173	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
632	3121476	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
633	3124886	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
634	3224683	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
635	3226176	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
636	3218540	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
637	3224748	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
638	3222815	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
639	3211135	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
640	3202757	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
641	3218743	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
642	3222667	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
643	3221530	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
644	3223529	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
645	3120376	15681	L-RA01-03	R 4-9	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
646	3123474	15681	L-RA01-03	R 4-9	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
647	3123263	15681	L-RA01-03	R 4-9	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
648	3125389	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
649	3125005	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
650	3111448	15681	L-RA01-03	R 4-9	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
651	3124805	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
652	3100282	15681	L-RA01-03	R 4-9	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
653	3118836	15681	L-RA01-03	R 4-9	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
654	3123135	15681	L-RA01-03	R 4-9	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
655	3123236	15681	L-RA01-03	R 4-9	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
656	3220404	15681	L-RA01-03	R 4-9	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
657	3221659	15681	L-RA01-03	R 4-9	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
658	3221448	15681	L-RA01-03	R 4-9	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
659	3218844	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
660	3124556	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
661	3121586	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
662	3121265	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
663	3126140	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
664	3224739	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
665	3215048	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
666	3220229	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
667	3207256	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
668	3222135	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
669	3225783	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
670	3223152	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
671	3223050	15681	L-RA01-03	R 4-9	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
672	3224564	15681	L-RA01-03	R 4-9	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
673	3206542	15681	L-RA01-03	R 4-9	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
674	3221062	15681	L-RA01-03	R 4-9	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
675	3218577	15681	L-RA01-03	R 4-9	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
101	1406785	15682	L-GU51-01	B 1-3	16	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
102	1607084	15682	L-GU51-01	B 1-3	25	2.89	0.10	52.19	4.92	0.80	0.07	0.10	58.19
103	1310849	15682	L-GU51-01	B 1-3	19	2.87	0.10	47.20	4.42	0.74	0.06	0.08	52.60

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
104	1103407	15682	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
107	1200225	15682	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
108	1411084	15682	L-GU51-01	B 1-3	16	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
109	1607066	15682	L-GU51-01	B 1-3	25	2.89	0.10	52.19	4.92	0.80	0.07	0.10	58.19
110	2701476	15682	L-GT22-03	B 3-6	37	2.42	0.07	41.78	4.04	0.62	0.06	0.09	46.65
111	2301756	15682	L-GT22-03	B 3-6	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
112	2401746	15682	L-GT22-03	B 3-6	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
113	2202655	15682	L-GT22-03	B 3-6	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
122	1604179	15682	L-GT22-03	B 3-6	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
123	1413275	15682	L-GT22-03	B 3-6	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
124	1200766	15682	L-GT22-03	B 3-6	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
135	1512524	15682	L-GT22-03	B 3-6	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
136	1310813	15682	L-GT22-03	B 3-6	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
140	2701265	15682	L-GS22-01	B 2-2	36	2.42	0.07	41.72	4.14	0.64	0.06	0.09	46.73
141	2302443	15682	L-GS22-01	B 2-2	32	2.42	0.06	45.57	3.95	0.57	0.05	0.22	50.41
142	2100170	15682	L-GS22-01	B 2-2	28	2.45	0.06	30.09	2.67	0.40	0.03	0.04	33.28
143	2304459	15682	L-GS22-01	B 2-2	32	2.42	0.06	45.57	3.95	0.57	0.05	0.22	50.41
144	2512103	15682	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
145	2406088	15682	L-GS22-01	B 2-2	30	2.46	0.06	34.68	2.98	0.45	0.04	0.06	38.26
147	2401012	15682	L-GS22-01	B 2-2	30	2.46	0.06	34.68	2.98	0.45	0.04	0.06	38.26
242	2517087	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
243	2503467	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
244	2520784	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
245	2511240	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
246	2520766	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
247	2511039	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
248	2505079	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
249	2517657	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
250	2512780	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
251	2518656	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
252	2505584	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
253	2511452	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
254	2510536	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
255	2504420	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
256	2516438	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
257	2516402	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
258	2506345	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
259	2502248	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
260	2520573	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
261	2518243	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
262	2513809	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
263	2511149	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
264	2516162	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
265	2302268	15682	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
266	2101666	15682	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
267	2608378	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
268	2611359	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
269	2606317	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
270	2620646	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
271	2604245	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
272	2612587	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
273	2618765	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
274	2612028	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
275	2600010	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
276	2602202	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
277	2616730	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
278	2613485	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
279	2603412	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
280	2402175	15682	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
281	2616327	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
282	2602036	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
283	2402276	15682	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
284	2621829	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
285	2620884	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
286	2403073	15682	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
287	2200134	15682	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
288	2205055	15682	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
289	2620049	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
290	2608517	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
291	2402340	15682	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
292	2204763	15682	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
293	2520867	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
294	2503072	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
295	2510076	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
296	2303112	15682	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
297	2520463	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
298	2304046	15682	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
299	2103417	15682	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
300	2501433	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
301	2517161	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
302	2512010	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
303	2305808	15682	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
304	2517217	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
305	2303305	15682	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
306	2101877	15682	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
307	2515329	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
308	2517482	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
309	2302874	15682	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
310	2100337	15682	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
311	2604135	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
312	2404606	15682	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
313	2200116	15682	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
314	2200704	15682	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
315	2620637	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
316	2604254	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
317	2600819	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
318	2406373	15682	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
319	2202334	15682	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
320	2612634	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
321	2614879	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
322	2602650	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
323	2403046	15682	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
324	2200501	15682	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
601	2200840	15682	L-GT22-03	B 3-6	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
607	2513880	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
608	2518169	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
609	2507720	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
610	2700643	15682	L-GW52-01	B 3-2	37	2.42	0.07	41.78	4.04	0.62	0.06	0.09	46.65
611	2300601	15682	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
612	2300279	15682	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
613	2304652	15682	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
614	1612357	15682	L-GU51-01	B 1-3	25	2.89	0.10	52.19	4.92	0.80	0.07	0.10	58.19
615	1606278	15682	L-GU51-01	B 1-3	25	2.89	0.10	52.19	4.92	0.80	0.07	0.10	58.19
616	2517179	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
617	1604758	15682	L-GU51-01	B 1-3	25	2.89	0.10	52.19	4.92	0.80	0.07	0.10	58.19
618	1404356	15682	L-GU51-01	B 1-3	16	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
619	1411479	15682	L-GU51-01	B 1-3	16	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
620	2502082	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
621	2521022	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
622	1200500	15682	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
623	1208042	15682	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
624	1206347	15682	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
625	1510589	15682	L-GU51-01	B 1-3	22	2.88	0.10	47.04	4.66	0.76	0.07	0.09	52.72
626	1311811	15682	L-GU51-01	B 1-3	19	2.87	0.10	47.20	4.42	0.74	0.06	0.08	52.60
627	1307152	15682	L-GU51-01	B 1-3	19	2.87	0.10	47.20	4.42	0.74	0.06	0.08	52.60
628	1107750	15682	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
629	1105477	15682	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
630	1507058	15682	L-GU51-01	B 1-3	22	2.88	0.10	47.04	4.66	0.76	0.07	0.09	52.72
631	1506683	15682	L-GU51-01	B 1-3	22	2.88	0.10	47.04	4.66	0.76	0.07	0.09	52.72
632	1500386	15682	L-GU51-01	B 1-3	22	2.88	0.10	47.04	4.66	0.76	0.07	0.09	52.72

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
633	1500846	15682	L-GU51-01	B 1-3	22	2.88	0.10	47.04	4.66	0.76	0.07	0.09	52.72
634	1107623	15682	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
635	1103700	15682	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
636	1106844	15682	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
637	1610157	15682	L-GU51-01	B 1-3	25	2.89	0.10	52.19	4.92	0.80	0.07	0.10	58.19
638	1503742	15682	L-GU51-01	B 1-3	22	2.88	0.10	47.04	4.66	0.76	0.07	0.09	52.72
639	2518041	15682	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
640	1302873	15682	L-GU51-01	B 1-3	19	2.87	0.10	47.20	4.42	0.74	0.06	0.08	52.60
641	1500157	15682	L-GU51-01	B 1-3	22	2.88	0.10	47.04	4.66	0.76	0.07	0.09	52.72
642	2610167	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
643	2615512	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
644	2622617	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
645	2607509	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
646	2605502	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
647	2622507	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
648	2404018	15682	L-GT22-03	B 3-6	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
649	2204846	15682	L-GT22-03	B 3-6	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
650	2616684	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
651	2600377	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
652	2606876	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
653	2601367	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
654	2101464	15682	L-GT22-03	B 3-6	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
655	2612735	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
656	2600314	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
657	2501670	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
658	2513634	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
659	2501157	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
660	2700414	15682	L-GT22-03	B 3-6	37	2.42	0.07	41.78	4.04	0.62	0.06	0.09	46.65
661	2503808	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
662	2514045	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
663	2512579	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
664	2517226	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
665	2516824	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
666	2500618	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
667	2500589	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
668	2503018	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
669	2622083	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
670	2617005	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
671	2612827	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
672	2600745	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
673	2502578	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
674	2510738	15682	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
180	3107082	15683	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
181	3206304	15683	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
182	3220018	15683	L-RA01-03	R 4-9	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
183	3116856	15683	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
184	3217578	15683	L-RA01-09	R 4-4	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
185	3103885	15683	L-RA01-09	R 4-4	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
186	3123373	15683	L-RA01-09	R 4-4	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
187	3116223	15683	L-RA01-09	R 4-4	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
188	3107102	15683	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
189	3201069	15683	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
190	3218505	15683	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
191	3202674	15683	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
601	3102143	15683	Calibration	N/A	Unirrad	6.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00
602	31124	15683	Calibration	N/A	Unirrad	5.98	0.00	69.40	0.82	0.06	0.01	0.72	71.00
603	31063	15683	Calibration	N/A	Unirrad	6.04	0.00	29.05	0.34	0.03	0.00	0.30	29.72
604	31123	15683	Calibration	N/A	Unirrad	5.98	0.00	69.36	0.82	0.06	0.01	0.72	70.96
605	3106718	15683	Calibration	N/A	Unirrad	6.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
606	31062	15683	Calibration	N/A	Unirrad	6.03	0.00	29.05	0.34	0.03	0.00	0.30	29.72
607	3108707	15683	Calibration	N/A	Unirrad	6.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
609	3203545	15683	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
610	3220751	15683	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
611	3127075	15683	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
612	3216258	15683	L-RA01-09	R 4-4	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
613	3214875	15683	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
614	3103555	15683	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
615	3118708	15683	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
617	3203379	15683	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
619	3104664	15683	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
620	3122163	15683	L-RA01-09	R 4-4	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
621	3222833	15683	L-RA01-09	R 4-4	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
622	3216139	15683	L-RA01-09	R 4-4	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
623	3217506	15683	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
624	3116167	15683	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
625	3118019	15683	L-RA01-09	R 4-4	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
626	3113006	15683	L-RA01-09	R 4-4	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
627	3120744	15683	L-RA01-09	R 4-4	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
629	3208127	15683	L-RA01-09	R 4-4	41	6.07	0.02	23.53	0.65	0.04	0.00	0.00	24.24
630	3211236	15683	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
631	3217266	15683	L-RA01-09	R 4-4	42	6.04	0.04	32.39	1.22	0.10	0.00	0.00	33.76
632	3218413	15683	L-RA01-09	R 4-4	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
633	3218669	15683	L-RA01-09	R 4-4	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
634	3222474	15683	L-RA01-09	R 4-4	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
635	3203774	15683	L-RA01-09	R 4-4	38	6.09	0.00	4.99	0.03	0.00	0.00	0.00	5.02
636	3207458	15683	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
637	3204654	15683	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
638	3206762	15683	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
639	3201380	15683	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
640	3226636	15683	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
641	3213629	15683	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
642	3122605	15683	L-RA01-09	R 4-4	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
643	3126470	15683	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
644	3105488	15683	L-RA01-09	R 4-4	40	6.08	0.01	16.57	0.32	0.01	0.00	0.00	16.92
645	3123245	15683	L-RA01-09	R 4-4	39	6.09	0.00	10.34	0.13	0.00	0.00	0.00	10.47
648	3111228	15683	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
649	3106819	15683	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
650	3100228	15683	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
651	3102318	15683	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
652	3111513	15683	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
653	3102620	15683	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
654	3106635	15683	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
655	3106846	15683	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
656	3204663	15683	L-RB01-08	R 5-4	49	6.09	0.00	10.46	0.12	0.00	0.00	0.00	10.59

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
657	3210136	15683	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
658	3201160	15683	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
659	3223675	15683	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
660	3208852	15683	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
661	3204810	15683	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
662	3201464	15683	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
663	3200815	15683	L-RB01-08	R 5-4	48	6.09	0.00	4.80	0.03	0.00	0.00	0.00	4.83
664	3204609	15683	L-RB01-08	R 5-4	49	6.09	0.00	10.46	0.12	0.00	0.00	0.00	10.59
665	3220182	15683	L-RB01-08	R 5-4	49	6.09	0.00	10.46	0.12	0.00	0.00	0.00	10.59
666	3206423	15683	L-RB01-08	R 5-4	49	6.09	0.00	10.46	0.12	0.00	0.00	0.00	10.59
667	3203030	15683	L-RB01-08	R 5-4	49	6.09	0.00	10.46	0.12	0.00	0.00	0.00	10.59
668	3110624	15683	L-RA01-10	R 4-3	46	6.08	0.02	22.42	0.59	0.04	0.00	0.00	23.06
670	3207716	15683	L-RA01-10	R 4-3	47	6.04	0.04	30.97	1.12	0.09	0.00	0.00	32.23
671	3220357	15683	L-RA01-10	R 4-3	47	6.04	0.04	30.97	1.12	0.09	0.00	0.00	32.23
672	3225453	15683	L-RB01-08	R 5-4	50	6.07	0.01	19.14	0.42	0.02	0.00	0.00	19.59
673	3204636	15683	L-RB01-08	R 5-4	49	6.09	0.00	10.46	0.12	0.00	0.00	0.00	10.59
674	3200705	15683	L-RB01-08	R 5-4	49	6.09	0.00	10.46	0.12	0.00	0.00	0.00	10.59
675	3217275	15683	L-RB01-08	R 5-4	49	6.09	0.00	10.46	0.12	0.00	0.00	0.00	10.59
101	1612210	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
102	1614824	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
103	1606884	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
104	1600330	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
105	1611275	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
106	1602071	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
107	1607571	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
108	1514513	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
109	1510874	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
110	1500184	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
111	1504144	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
112	1500727	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
113	1514329	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
114	1510883	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
115	1508865	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
116	1405714	15684	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
117	1312764	15684	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
118	1303652	15684	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
119	1301387	15684	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
120	1302670	15684	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
121	1101555	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
122	1110280	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
123	1311215	15684	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
124	1408518	15684	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
125	1408554	15684	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
126	1206677	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
127	1205788	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
128	1208161	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
129	1207447	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
130	1401608	15684	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
131	1607048	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
132	1304889	15684	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
133	1506288	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
134	1502862	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
135	1514614	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
136	1514585	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
137	1502009	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
138	1514374	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
139	1511543	15684	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
140	1312856	15684	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
141	1302038	15684	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
143	1308032	15684	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
144	1308537	15684	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
145	1110060	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
146	1104837	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
147	1205430	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
148	1202214	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
149	1205210	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
150	1615042	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
151	1608561	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
152	1612413	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
153	1614777	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
154	1612274	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
155	1606114	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
156	1408509	15684	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
158	1408177	15684	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
159	1413468	15684	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
160	1602724	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
161	1606756	15684	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
163	2621728	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
164	2404615	15684	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
165	2202352	15684	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
166	1401754	15684	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
167	1201307	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
168	2515860	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
169	2700660	15684	L-GW52-01	B 3-2	37	2.42	0.07	41.78	4.04	0.62	0.06	0.09	46.65
170	2302130	15684	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
171	2505272	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
172	2501588	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
173	2516878	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
174	2513827	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
324	1103167	15684	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
601	2517208	15684	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
602	2505236	15684	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
603	2701430	15684	L-GT22-03	B 3-6	37	2.42	0.07	41.78	4.04	0.62	0.06	0.09	46.65
604	2305449	15684	L-GT22-03	B 3-6	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
605	2305312	15684	L-GT22-03	B 3-6	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
606	2101363	15684	L-GT22-03	B 3-6	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
607	2620747	15684	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
608	2612625	15684	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
609	2613413	15684	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
610	2622175	15684	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
611	2604887	15684	L-GT22-03	B 3-6	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
612	2305853	15684	L-GT22-03	B 3-6	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
613	2406355	15684	L-GT22-03	B 3-6	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
614	2204855	15684	L-GT22-03	B 3-6	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
615	2610223	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
616	2613505	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
617	2610205	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
618	2620655	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
619	2606389	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
620	2614769	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
621	2610883	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
622	2618866	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
623	2617106	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
624	2605583	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
625	2616776	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
626	2405522	15684	L-GS22-01	B 2-2	30	2.46	0.06	34.68	2.98	0.45	0.04	0.06	38.26
627	2505025	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
628	2518371	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
629	2511663	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
630	2504585	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
631	2513717	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
632	2517823	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
633	2504706	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
634	2506814	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
635	2516759	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
636	2400287	15684	L-GS22-01	B 2-2	30	2.46	0.06	34.68	2.98	0.45	0.04	0.06	38.26
637	2406153	15684	L-GS22-01	B 2-2	30	2.46	0.06	34.68	2.98	0.45	0.04	0.06	38.26
638	2608003	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
640	2701357	15684	L-GS22-01	B 2-2	36	2.42	0.07	41.72	4.14	0.64	0.06	0.09	46.73
641	2700055	15684	L-GS22-01	B 2-2	36	2.42	0.07	41.72	4.14	0.64	0.06	0.09	46.73

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
642	2304138	15684	L-GS22-01	B 2-2	32	2.42	0.06	45.57	3.95	0.57	0.05	0.22	50.41
643	2303552	15684	L-GS22-01	B 2-2	32	2.42	0.06	45.57	3.95	0.57	0.05	0.22	50.41
644	2303560	15684	L-GS22-01	B 2-2	32	2.42	0.06	45.57	3.95	0.57	0.05	0.22	50.41
645	2103352	15684	L-GS22-01	B 2-2	28	2.45	0.06	30.09	2.67	0.40	0.03	0.04	33.28
646	2102225	15684	L-GS22-01	B 2-2	28	2.45	0.06	30.09	2.67	0.40	0.03	0.04	33.28
647	2102077	15684	L-GS22-01	B 2-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
648	2504347	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
649	2516061	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
650	2518142	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
651	2520288	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
652	2100245	15684	L-GS22-01	B 2-2	28	2.45	0.06	30.09	2.67	0.40	0.03	0.04	33.28
653	2504834	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
654	2517289	15684	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
656	2611002	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
657	2615016	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
658	2601147	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
659	2607031	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
660	2607325	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
661	2511810	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
662	2520656	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
663	2516850	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
664	2608434	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
665	2621407	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
666	2602375	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
667	2201178	15684	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
668	2401636	15684	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
669	2402314	15684	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
670	2605152	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
671	2600653	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
672	2606775	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
673	2603383	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
674	2620509	15684	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
101	2502616	15685	Calibration	N/A	Unirrad	2.43	0.00	63.14	0.75	0.05	0.01	0.44	64.38
102	25064	15685	Calibration	N/A	Unirrad	2.49	0.00	11.65	0.14	0.01	0.00	0.12	11.91
103	25123	15685	Calibration	N/A	Unirrad	2.47	0.00	27.94	0.33	0.02	0.00	0.29	28.59
104	25163	15685	Calibration	N/A	Unirrad	2.46	0.00	38.17	0.51	0.03	0.01	0.10	38.81
154	1612146	15685	L-GS22-01	B 2-2	26	2.89	0.09	52.10	4.74	0.75	0.07	0.10	57.85
155	1605629	15685	L-GU51-01	B 1-3	25	2.89	0.10	52.19	4.92	0.80	0.07	0.10	58.19
156	2620628	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
157	1407712	15685	L-GU51-01	B 1-3	16	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
158	2104416	15685	L-GS22-01	B 2-2	28	2.45	0.06	30.09	2.67	0.40	0.03	0.04	33.28
159	1104478	15685	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
160	1503329	15685	L-GU51-01	B 1-3	22	2.88	0.10	47.04	4.66	0.76	0.07	0.09	52.72
161	1105055	15685	L-GS22-01	B 2-2	14	2.90	0.09	34.30	2.98	0.47	0.04	0.03	37.91
162	1203626	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
163	1402762	15685	L-GU51-01	B 1-3	16	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
164	1601036	15685	L-GU51-01	B 1-3	25	2.89	0.10	52.19	4.92	0.80	0.07	0.10	58.19
165	1600616	15685	L-GS22-01	B 2-2	26	2.89	0.09	52.10	4.74	0.75	0.07	0.10	57.85
166	2606243	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
167	2620316	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
168	2402249	15685	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
169	2204525	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
170	2604034	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
171	2616455	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
172	2618408	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
173	2401672	15685	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
174	2617555	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
175	2611332	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
176	2605134	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
177	2615429	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
178	2615236	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
179	2613514	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
180	2202058	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
181	2202132	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
182	2305229	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
183	2520519	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
184	2517419	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
185	2511508	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
186	2300885	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
187	2102317	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
188	2518804	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
189	2517354	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
190	2303644	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
191	2100667	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
192	2102804	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
193	2513753	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
194	2301619	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
195	2102150	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
196	2518720	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
197	2502440	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
198	2303166	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
199	2200309	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
200	2200648	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
201	2200721	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
202	2402305	15685	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
203	2600258	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
204	2306356	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
205	2602853	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
206	2617077	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
207	2618004	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
208	2621636	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
209	2605125	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
210	2617537	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
211	2601064	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
212	2620269	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
213	2622368	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
214	2406236	15685	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
215	2405605	15685	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
216	2400572	15685	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
217	2404155	15685	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
218	2404247	15685	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
219	2401158	15685	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
220	2201629	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
221	2104167	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
222	2103408	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
223	2103058	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
224	2305568	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
225	2306026	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
226	2303029	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
227	2305752	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
228	2304037	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
229	2302700	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43
230	2701348	15685	L-GW52-01	B 3-2	37	2.42	0.07	41.78	4.04	0.62	0.06	0.09	46.65
231	2700165	15685	L-GW52-01	B 3-2	37	2.42	0.07	41.78	4.04	0.62	0.06	0.09	46.65
232	2507418	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
233	2505723	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
234	2507344	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
235	2501359	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
236	2502477	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
237	2510572	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
238	2515310	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
239	2511378	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
240	2511562	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
241	2511737	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
242	2506428	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
243	2507133	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
244	2511306	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
245	2615079	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
246	2620334	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
247	2614778	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
248	2602348	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
249	2616832	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
250	2618417	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
251	2616805	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
252	2605620	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
253	2613467	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
254	2600047	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
255	2622579	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
256	2606546	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
257	2517473	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
258	2512543	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
259	2515255	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
260	2518068	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
261	2500039	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
262	2511746	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
263	2513423	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
264	1107127	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
265	1608552	15685	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
266	1402625	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
267	1208785	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
268	1203507	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
269	1200480	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
270	1203139	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
271	1208179	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
272	1401846	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
273	1304202	15685	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
274	1107118	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
275	1101308	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
276	1104709	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
277	1101876	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
278	1100529	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
279	1306667	15685	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
280	1304835	15685	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
281	1304725	15685	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
282	1611376	15685	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
283	1607618	15685	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
284	1412763	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
285	1401056	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
286	1402129	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
287	1205063	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
288	1200683	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
289	1200720	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
290	1200436	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
291	1201022	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
292	1105515	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
293	1100235	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
294	1103113	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
295	1100684	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
296	1101638	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
297	1103755	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
298	1107668	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
299	1204660	15685	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
300	1405584	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
301	1405254	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
302	1403018	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
303	1406428	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
304	1401644	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
305	1405263	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
306	1412175	15685	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
307	1607012	15685	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
308	1613127	15685	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
309	1614566	15685	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
310	1605252	15685	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
311	1614034	15685	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
312	1310427	15685	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
313	1311022	15685	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
314	1303688	15685	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
315	1312570	15685	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
316	1310106	15685	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
317	1312240	15685	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
318	1310610	15685	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
319	1511258	15685	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
320	1500258	15685	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
321	1505538	15685	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
322	1504824	15685	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
323	1514412	15685	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
324	1504319	15685	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
601	2302378	15685	L-GW52-01	B 3-2	33	2.42	0.05	46.13	3.53	0.47	0.04	0.22	50.43

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
602	2100759	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
603	2517363	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
604	2516777	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
605	2517704	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
606	2511350	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
607	2512754	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
608	2517244	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
609	2608755	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
610	2605455	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
611	2622433	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
612	2622478	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
613	2607471	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
614	2611157	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
615	2614640	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
616	2610240	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
617	2101758	15685	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
618	2515513	15685	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
619	2701274	15685	L-GW52-01	B 3-2	37	2.42	0.07	41.78	4.04	0.62	0.06	0.09	46.65
624	1104780	15685	Calibration	N/A	Unirrad	2.94	0.00	16.43	0.22	0.01	0.00	0.05	16.71
625	1613834	15685	Calibration	N/A	Unirrad	2.92	0.00	54.38	0.72	0.04	0.01	0.14	55.30
626	15124	15685	Calibration	N/A	Unirrad	2.91	0.00	32.83	0.48	0.05	0.02	0.08	33.45
627	1512019	15685	Calibration	N/A	Unirrad	2.91	0.00	45.53	0.61	0.04	0.01	0.12	46.31
628	1613659	15685	Calibration	N/A	Unirrad	2.92	0.00	54.40	0.72	0.04	0.01	0.14	55.31
629	15064	15685	Calibration	N/A	Unirrad	2.95	0.00	13.83	0.16	0.01	0.00	0.14	14.15
630	1103425	15685	Calibration	N/A	Unirrad	2.93	0.00	16.45	0.22	0.01	0.00	0.05	16.73
631	1412359	15685	Calibration	N/A	Unirrad	2.95	0.00	30.09	0.39	0.02	0.00	0.08	30.59

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
632	1300545	15685	Calibration	N/A	Unirrad	2.90	0.00	45.40	0.60	0.04	0.01	0.12	46.17
633	1501827	15685	Calibration	N/A	Unirrad	2.92	0.00	45.58	0.61	0.04	0.01	0.12	46.36
634	25161	15685	Calibration	N/A	Unirrad	2.46	0.00	37.81	0.50	0.03	0.01	0.01	38.45
635	25122	15685	Calibration	N/A	Unirrad	2.47	0.00	27.93	0.33	0.02	0.00	0.29	28.58
636	2303222	15685	Calibration	N/A	Unirrad	2.43	0.00	52.58	0.64	0.04	0.01	0.42	53.69
637	2103140	15685	Calibration	N/A	Unirrad	2.47	0.00	18.97	0.26	0.02	0.00	0.05	19.30
638	2500452	15685	Calibration	N/A	Unirrad	2.43	0.00	62.96	0.73	0.04	0.01	0.48	64.22
639	25063	15685	Calibration	N/A	Unirrad	2.49	0.00	11.66	0.14	0.01	0.00	0.12	11.93
640	2700468	15685	Calibration	N/A	Unirrad	2.45	0.00	46.31	0.64	0.05	0.01	0.13	47.14
641	2701624	15685	Calibration	N/A	Unirrad	2.45	0.00	46.52	0.68	0.07	0.02	0.12	47.43
642	2402626	15685	Calibration	N/A	Unirrad	2.47	0.00	30.60	0.42	0.03	0.01	0.08	31.15
643	2100153	15685	Calibration	N/A	Unirrad	2.48	0.00	18.91	0.25	0.01	0.00	0.05	19.23
644	25001	15685	Calibration	N/A	Unirrad	2.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
645	25004	15685	Calibration	N/A	Unirrad	2.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00
646	15004	15685	Calibration	N/A	Unirrad	2.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00
647	15061	15685	Calibration	N/A	Unirrad	2.95	0.00	13.84	0.16	0.01	0.00	0.14	14.16
648	15002	15685	Calibration	N/A	Unirrad	2.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00
649	15122	15685	Calibration	N/A	Unirrad	2.91	0.00	32.81	0.48	0.05	0.02	0.08	33.43
652	1102470	15685	L-GS22-01	B 2-2	14	2.90	0.09	34.30	2.98	0.47	0.04	0.03	37.91
653	1104525	15685	L-GS22-01	B 2-2	14	2.90	0.09	34.30	2.98	0.47	0.04	0.03	37.91
654	1106586	15685	L-GS22-01	B 2-2	14	2.90	0.09	34.30	2.98	0.47	0.04	0.03	37.91
655	1106137	15685	L-GS22-01	B 2-2	14	2.90	0.09	34.30	2.98	0.47	0.04	0.03	37.91
656	1103672	15685	L-GS22-01	B 2-2	14	2.90	0.09	34.30	2.98	0.47	0.04	0.03	37.91
657	1305787	15685	L-GS22-01	B 2-2	20	2.87	0.09	46.87	4.22	0.68	0.06	0.08	52.02
658	1311334	15685	L-GS22-01	B 2-2	20	2.87	0.09	46.87	4.22	0.68	0.06	0.08	52.02
659	1302579	15685	L-GS22-01	B 2-2	20	2.87	0.09	46.87	4.22	0.68	0.06	0.08	52.02

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
660	1210125	15685	L-GS22-01	B 2-2	14	2.90	0.09	34.30	2.98	0.47	0.04	0.03	37.91
661	1210226	15685	L-GS22-01	B 2-2	14	2.90	0.09	34.30	2.98	0.47	0.04	0.03	37.91
662	1208657	15685	L-GS22-01	B 2-2	14	2.90	0.09	34.30	2.98	0.47	0.04	0.03	37.91
663	1303248	15685	L-GS22-01	B 2-2	20	2.87	0.09	46.87	4.22	0.68	0.06	0.08	52.02
664	1504667	15685	L-GS22-01	B 2-2	23	2.88	0.10	46.88	4.50	0.72	0.06	0.09	52.34
665	1507619	15685	L-GS22-01	B 2-2	23	2.88	0.10	46.88	4.50	0.72	0.06	0.09	52.34
666	1504658	15685	L-GS22-01	B 2-2	23	2.88	0.10	46.88	4.50	0.72	0.06	0.09	52.34
667	1200344	15685	L-GT22-03	B 3-6	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
668	1204542	15685	L-GT22-03	B 3-6	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
669	1410646	15685	L-GT22-03	B 3-6	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
670	1404448	15685	L-GT22-03	B 3-6	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
671	1602181	15685	L-GS22-01	B 2-2	26	2.89	0.09	52.10	4.74	0.75	0.07	0.10	57.85
672	1607479	15685	L-GS22-01	B 2-2	26	2.89	0.09	52.10	4.74	0.75	0.07	0.10	57.85
673	1603676	15685	L-GS22-01	B 2-2	26	2.89	0.09	52.10	4.74	0.75	0.07	0.10	57.85
674	1608083	15685	L-GS22-01	B 2-2	26	2.89	0.09	52.10	4.74	0.75	0.07	0.10	57.85
101	0603381	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
103	0500809	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
104	0301450	15686	L-BB01-04	S 1-1	7	0.70	0.03	15.29	1.89	0.33	0.03	0.04	17.62
105	0402072	15686	L-BB01-04	S 1-1	4	0.69	0.03	17.17	2.13	0.38	0.04	0.05	19.80
106	0201460	15686	L-BB01-04	S 1-1	10	0.70	0.03	13.69	1.67	0.29	0.03	0.03	15.73
108	0410185	15686	L-BB01-08	S 3-2	6	0.69	0.02	18.24	1.76	0.26	0.02	0.05	20.36
109	0205677	15686	L-BB01-08	S 3-2	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
110	0530132	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
111	0532213	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
112	0311003	15686	L-BB01-08	S 3-2	9	0.70	0.02	15.88	1.53	0.23	0.02	0.04	17.73
113	0505804	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
114	0407067	15686	L-BB01-07	S 3-1	6	0.69	0.02	18.24	1.76	0.26	0.02	0.05	20.36
115	0202478	15686	L-BB01-07	S 3-1	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
116	0308168	15686	L-BB01-07	S 3-1	9	0.70	0.02	15.88	1.53	0.23	0.02	0.04	17.73
118	0510002	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
401	0504107	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
402	0704628	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
403	0604555	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
404	0504502	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
405	0607258	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
406	0205154	15686	L-BB01-04	S 1-1	10	0.70	0.03	13.69	1.67	0.29	0.03	0.03	15.73
407	0618561	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
408	0800117	15686	L-BB01-04	S 1-1	10	0.70	0.03	13.69	1.67	0.29	0.03	0.03	15.73
409	0602209	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
410	0624153	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
411	0628324	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
412	0625161	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
413	0628544	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
414	0530224	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
415	0531048	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
416	0531407	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
417	0530811	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
418	0515574	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
419	0525806	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
420	0534808	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
421	0408084	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
422	0408645	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
423	0412358	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
424	0412515	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
425	0411507	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
426	0310655	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
427	0314476	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
428	0316126	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
429	0315026	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
430	0313533	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
431	0210106	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
432	0211462	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
433	0204202	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
434	0212719	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
435	0214486	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
436	0704664	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
437	0705048	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
438	0626068	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
439	0623659	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
440	0515823	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
441	0528058	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
442	0512072	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
443	0528004	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
444	0530563	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
445	0530114	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
446	0531342	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
447	0534256	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
448	0411010	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
449	0410084	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
450	0413303	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
451	0411617	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
452	0413045	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
453	0412753	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
454	0411222	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
455	0410764	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
456	0412616	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
457	0410387	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
458	0315504	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
459	0315035	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
460	0314734	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
461	0313506	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
462	0313275	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
463	0314303	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
464	0311700	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
465	0312487	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
466	0312516	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
467	0314788	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
468	0313423	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
469	0214660	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
470	0214726	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
471	0216513	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
472	0212277	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
473	0216448	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
474	0215559	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
475	0216686	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
476	0200408	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
477	0214578	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
478	0700530	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
479	0701209	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
480	0703454	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
481	0104046	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
482	0104708	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
483	0704325	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
484	0104468	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
485	0104414	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
486	0105210	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
487	0104477	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
488	0103846	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
489	0702805	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
490	0800227	15686	L-BB01-07	S 3-1	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
491	0801482	15686	L-BB01-03	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
492	0213736	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
493	0216338	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
494	0215678	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
495	0215707	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
496	0215357	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
497	0408562	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
498	0215760	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
499	0630553	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
500	0625152	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
501	0314054	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
502	0533423	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
503	0531654	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
504	0201746	15686	L-BB01-04	S 1-1	10	0.70	0.03	13.69	1.67	0.29	0.03	0.03	15.73
505	0502347	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
506	0702069	15686	L-BB01-04	S 1-1	10	0.70	0.03	13.69	1.67	0.29	0.03	0.03	15.73
507	0301340	15686	L-BB01-04	S 1-1	7	0.70	0.03	15.29	1.89	0.33	0.03	0.04	17.62
508	0702161	15686	L-BB01-07	S 3-1	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
601	0603464	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
602	0604519	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
603	0603289	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
604	0600577	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
608	0607184	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
609	0500082	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
610	0507333	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
611	0507782	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
613	0501128	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
614	0501779	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
615	0501265	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
616	0211224	15686	L-BB01-04	S 1-1	10	0.70	0.03	13.69	1.67	0.29	0.03	0.03	15.73
617	0532120	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
618	0605269	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
619	0601504	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
620	0608165	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
621	0700219	15686	L-BB01-04	S 1-1	10	0.70	0.03	13.69	1.67	0.29	0.03	0.03	15.73
622	0100821	15686	L-BB01-04	S 1-1	10	0.70	0.03	13.69	1.67	0.29	0.03	0.03	15.73

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
623	0608313	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
624	0606378	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
625	0606461	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
626	0605572	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
627	0537510	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
628	0537069	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
629	0518333	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
630	0516133	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
631	0536272	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
632	0511625	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
633	0517269	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
634	0608753	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
635	0613676	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
636	0630680	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
637	0606681	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
638	0624824	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
639	0412652	15686	L-BB01-08	S 3-2	6	0.69	0.02	18.24	1.76	0.26	0.02	0.05	20.36
640	0408755	15686	L-BB01-08	S 3-2	6	0.69	0.02	18.24	1.76	0.26	0.02	0.05	20.36
641	0202525	15686	L-BB01-08	S 3-2	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
642	0314384	15686	L-BB01-08	S 3-2	9	0.70	0.02	15.88	1.53	0.23	0.02	0.04	17.73
643	0315127	15686	L-BB01-08	S 3-2	9	0.70	0.02	15.88	1.53	0.23	0.02	0.04	17.73
644	0105624	15686	L-BB01-08	S 3-2	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
645	0106089	15686	L-BB01-08	S 3-2	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
646	0615216	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
647	0622889	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
648	0618543	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
649	0504648	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
650	0524302	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
651	0526336	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
652	0531728	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
653	0523779	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
654	0627076	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
655	0606874	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
656	0607561	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
657	0601558	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
658	0505362	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
659	0506388	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
660	0507039	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
661	0510139	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
662	0610275	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
663	0617865	15686	L-BB01-08	S 3-2	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
664	0207428	15686	L-BB01-08	S 3-2	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
665	0603327	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
666	0502200	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
667	0506206	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
668	0504363	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
669	0508617	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
670	0407702	15686	L-BB01-07	S 3-1	6	0.69	0.02	18.24	1.76	0.26	0.02	0.05	20.36
671	0400083	15686	L-BB01-07	S 3-1	6	0.69	0.02	18.24	1.76	0.26	0.02	0.05	20.36
672	0203652	15686	L-BB01-07	S 3-1	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
673	0201342	15686	L-BB01-07	S 3-1	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
674	0500385	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
675	0501808	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
676	0506453	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
677	0502585	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
678	0503622	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
679	0504556	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
680	0508451	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
681	0508671	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
682	0508516	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
683	0302845	15686	L-BB01-07	S 3-1	9	0.70	0.02	15.88	1.53	0.23	0.02	0.04	17.73
684	0302203	15686	L-BB01-07	S 3-1	9	0.70	0.02	15.88	1.53	0.23	0.02	0.04	17.73
685	0701153	15686	L-BB01-07	S 3-1	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
686	0603684	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
687	0604472	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
688	0600430	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
689	0602878	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
690	0100683	15686	L-BB01-07	S 3-1	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
691	0102609	15686	L-BB01-07	S 3-1	12	0.71	0.02	13.82	1.32	0.19	0.02	0.03	15.40
692	0600633	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
693	0608349	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
694	0602108	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
695	0604876	15686	L-BB01-07	S 3-1	3	0.68	0.02	26.28	2.10	0.29	0.02	0.07	28.78
696	0414466	15686	Calibration	N/A	Unirrad	0.70	0.00	24.08	0.32	0.02	0.00	0.71	25.13
697	0100500	15686	Calibration	N/A	Unirrad	0.72	0.00	14.20	0.19	0.02	0.00	0.04	14.46
698	0301754	15686	Calibration	N/A	Unirrad	0.71	0.00	19.11	0.23	0.00	0.00	0.07	19.42
699	0511165	15686	Calibration	N/A	Unirrad	0.69	0.00	34.55	0.43	0.01	0.00	0.08	35.07
700	05001	15686	Calibration	N/A	Unirrad	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
701	05061	15686	Calibration	N/A	Unirrad	0.73	0.00	3.40	0.04	0.00	0.00	0.04	3.48
702	05431	15686	Calibration	N/A	Unirrad	0.70	0.00	28.71	0.35	0.01	0.00	0.10	29.17
703	05274	15686	Calibration	N/A	Unirrad	0.71	0.00	18.29	0.22	0.02	0.00	0.19	18.71
704	0307748	15686	Calibration	N/A	Unirrad	0.71	0.00	19.15	0.26	0.03	0.01	0.06	19.50
705	05062	15686	Calibration	N/A	Unirrad	0.73	0.00	3.40	0.04	0.00	0.00	0.04	3.48
706	0101334	15686	Calibration	N/A	Unirrad	0.72	0.00	14.28	0.19	0.02	0.00	0.04	14.54
707	05004	15686	Calibration	N/A	Unirrad	0.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00
708	05122	15686	Calibration	N/A	Unirrad	0.72	0.00	8.13	0.10	0.01	0.00	0.08	8.32
709	0401863	15686	Calibration	N/A	Unirrad	0.70	0.00	23.70	0.32	0.03	0.01	0.07	24.13
710	05121	15686	Calibration	N/A	Unirrad	0.72	0.00	8.13	0.96	0.01	0.00	0.08	9.18
711	0527674	15686	Calibration	N/A	Unirrad	0.69	0.00	34.80	0.46	0.03	0.01	0.10	35.39
712	05273	15686	Calibration	N/A	Unirrad	0.71	0.00	18.31	0.22	0.02	0.00	0.19	18.73
713	05432	15686	Calibration	N/A	Unirrad	0.70	0.00	28.71	0.35	0.01	0.00	0.10	29.17
741	0624465	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
742	0615739	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
743	0626528	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
744	0626573	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
745	0610239	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
746	0610818	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
747	0615409	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
748	0631800	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
749	0315310	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
750	0622532	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
751	0217061	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
752	0411534	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
753	0628315	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
754	0610607	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
755	0524623	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
756	0312083	15686	L-BB01-13	S 2-3	8	0.70	0.03	15.60	1.70	0.28	0.02	0.04	17.66
757	0531737	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
758	0535154	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
759	0614648	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
760	0624382	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
761	0618516	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
762	0411056	15686	L-BB01-13	S 2-3	5	0.69	0.03	17.72	1.93	0.31	0.03	0.05	20.08
763	0528325	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
764	0216356	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
765	0623860	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
766	0623724	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
767	0404355	15686	L-BB01-04	S 1-1	4	0.69	0.03	17.17	2.13	0.38	0.04	0.05	19.80
768	0302578	15686	L-BB01-04	S 1-1	7	0.70	0.03	15.29	1.89	0.33	0.03	0.04	17.62
769	0502228	15686	L-BB01-04	S 1-1	1	0.68	0.03	24.34	2.54	0.41	0.03	0.07	27.43
770	0200343	15686	L-BB01-04	S 1-1	10	0.70	0.03	13.69	1.67	0.29	0.03	0.03	15.73
771	0535466	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
772	0705084	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
773	0527703	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
774	0106614	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
775	0202635	15686	L-BB01-13	S 2-3	11	0.71	0.02	13.75	1.48	0.23	0.02	0.03	15.54
776	0532763	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
777	0536622	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
778	0518387	15686	L-BB01-13	S 2-3	2	0.68	0.03	25.37	2.31	0.35	0.03	0.07	28.14
101	1604253	15687	L-GS22-01	B 2-2	26	2.89	0.09	52.10	4.74	0.75	0.07	0.10	57.85

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
102	1408765	15687	L-GS22-01	B 2-2	17	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
103	1203662	15687	L-GS22-01	B 2-2	14	2.90	0.09	34.30	2.98	0.47	0.04	0.03	37.91
108	1512477	15687	L-GS22-01	B 2-2	23	2.88	0.10	46.88	4.50	0.72	0.06	0.09	52.34
109	1305439	15687	L-GS22-01	B 2-2	20	2.87	0.09	46.87	4.22	0.68	0.06	0.08	52.02
601	2202278	15687	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
602	2200805	15687	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
603	2401048	15687	L-GW52-01	B 3-2	31	2.46	0.05	34.11	2.62	0.37	0.03	0.06	37.23
604	2607563	15687	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
605	1607416	15687	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
606	1607075	15687	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
607	1615502	15687	L-GW52-01	B 3-2	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
608	1514365	15687	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
609	1513339	15687	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
610	1310187	15687	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
611	1310472	15687	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
612	1303872	15687	L-GW52-01	B 3-2	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
613	1105102	15687	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
614	1103012	15687	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
615	1103460	15687	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
616	1402542	15687	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
617	1410316	15687	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
618	1207520	15687	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
619	1203709	15687	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
620	1511469	15687	L-GW52-01	B 3-2	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
621	1401828	15687	L-GW52-01	B 3-2	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
622	1100767	15687	L-GW52-01	B 3-2	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
623	2202518	15687	L-GW52-01	B 3-2	29	2.45	0.05	28.98	2.29	0.31	0.02	0.04	31.69
641	2516281	15687	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
642	2603044	15687	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
643	2514128	15687	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
644	2515585	15687	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
645	2621223	15687	L-GS22-01	B 2-2	34	2.43	0.05	53.87	3.78	0.47	0.04	0.26	58.47
646	2516503	15687	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
647	2516319	15687	L-GW52-01	B 3-2	35	2.43	0.03	55.13	3.30	0.38	0.03	0.26	59.13
648	1402660	15687	L-GS22-01	B 2-2	17	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
649	1505363	15687	L-GS22-01	B 2-2	23	2.88	0.10	46.88	4.50	0.72	0.06	0.09	52.34
650	1407748	15687	L-GS22-01	B 2-2	17	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
651	1412846	15687	L-GS22-01	B 2-2	17	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
652	1404668	15687	L-GS22-01	B 2-2	17	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
653	1401882	15687	L-GT22-03	B 3-6	18	2.92	0.08	39.40	3.21	0.50	0.04	0.06	43.28
654	1601164	15687	L-GT22-03	B 3-6	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
655	1613457	15687	L-GT22-03	B 3-6	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
656	1603483	15687	L-GT22-03	B 3-6	27	2.90	0.09	52.06	4.53	0.70	0.06	0.10	57.53
657	1104800	15687	L-GT22-03	B 3-6	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
658	1305724	15687	L-GT22-03	B 3-6	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
659	1308564	15687	L-GT22-03	B 3-6	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
660	1103315	15687	L-GT22-03	B 3-6	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
661	1101059	15687	L-GT22-03	B 3-6	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
662	1103443	15687	L-GT22-03	B 3-6	15	2.91	0.08	33.30	2.73	0.41	0.03	0.03	36.59
663	1306117	15687	L-GT22-03	B 3-6	21	2.87	0.08	46.59	4.02	0.63	0.05	0.08	51.45
664	1512486	15687	L-GT22-03	B 3-6	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
665	1513265	15687	L-GT22-03	B 3-6	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90

Liner Cell	Rod Number	Liner Number	Assembly Number	Liner no.	POB Category	Th-232 (kg)	U-232 (g)	U-233 (g)	U-234 (g)	U-235 (g)	U-236 (g)	U-238 (g)	U-Total (g)
666	1507545	15687	L-GT22-03	B 3-6	24	2.88	0.09	46.71	4.29	0.67	0.06	0.09	51.90
667	1208078	15687	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
668	1401166	15687	L-GU51-01	B 1-3	16	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
669	1604318	15687	L-GU51-01	B 1-3	25	2.89	0.10	52.19	4.92	0.80	0.07	0.10	58.19
670	1200665	15687	L-GU51-01	B 1-3	13	2.90	0.10	35.40	3.25	0.54	0.05	0.03	39.36
671	1407187	15687	L-GU51-01	B 1-3	16	2.92	0.09	40.74	3.63	0.61	0.05	0.06	45.17
672	1605876	15687	L-GU51-01	B 1-3	25	2.89	0.10	52.19	4.92	0.80	0.07	0.10	58.19
673	1311738	15687	L-GU51-01	B 1-3	19	2.87	0.10	47.20	4.42	0.74	0.06	0.08	52.60
674	1306584	15687	L-GU51-01	B 1-3	19	2.87	0.10	47.20	4.42	0.74	0.06	0.08	52.60

Letter numbers associated with the above data and liners are as follows:

Letter	Date	Liner Numbers
WAPD-NRF(L) C-117	June 26, 1987	15685, 15686, 15687
WAPD-NRF(L) C-123	July 8, 1987	15687
WAPD-NRF(L) C-149	September 15, 1987	15683, 15685, 15686
WAPD-NRF(L) C-93	March 26, 1987	15681, 15682
WAPD-NRF(L) C-104	April 30, 1987	15683, 15684