LA - 406

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This document contains 123 pages

(SUMMARY OF RESULTS)

BUILDING D PLUTONIUM PURIFICATION

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ABSTRACT

LA - 406 can be separated into two independent sections: 1) the data from and results of all experimental purification runs on scales ranging from 5 milligrams to 8 grams; 2) the data from and results of all experimental and production purification runs on the 160-gram scale. In each of these sections, an attempt has been made to present data which provide a complete picture of the purity of a sample of plutonium from the time of its receipt at this site, through its purification and finally its reduction to the metal.

(SUMMARY OF RESULTS)

BUILDING D PLUTONIUM PURIFICATION

TABLE I

Summary of all Experimental and Production
Purification Runs, up to and including
Those on the 8-gram Scale.

Notes
on the Headings

1. All purification runs up to, but not including 200-P were performed by the Recovery phase. From 200-P, all purification runs were performed by the Purification phase.

2. Lot numbers were assigned at this site. (Run numbers and lot numbers were assigned consecutively, to indicate the order in which material was received; i.e., the combination of run numbers and lot numbers forms a series of consecutive numbers).

The numbers and letters in paranthesis are designations assigned at Clinton: the number denotes the Clinton batch, and the letter denotes the lot which was taken from the batch indicated.

3. The notations have the following meanings:

O Oxalate precipitation; Reduction to Pu^{III} with KI, followed by precipitation of $Pu_2(C_2O_4)_3$ using $H_2C_2O_4$ (in solution or as a solid), followed by two H_2O washes of the precipitate.

O_2 Oxalate precipitation: Reduction to Pu^{III} with ~5.5M HI, followed by precipitation of $Pu_2(C_2O_4)_3$ using $H_2C_2O_4$ (in solution or as a solid), followed by two washes of the precipitate with a 0.1M HNO_3 -- 0.1M HCl solution, and one H_2O wash.

A Acetate precipitation: Oxidation to Pu^{VI} with $NaBrO_3$ and HNO_3, followed by precipitation of $NaPuO_2\ Ac_3$ using a NaAc -- $NaNO_3$ solution, followed by two washes of the precipitate with a buffered (pH = 5) $NaNO_3$ -- NaAc -- HAc solution.

E Ether extraction: "A" (above), or just oxidation to Pu^{VI} with $NaBrO_3$ and HNO_3, followed by an extraction into ethyl ether using NH_4NO_3 as a salting out agent in a 0.5 -- 1.5M HNO_3 solution.

C Ether extraction: Oxalation to Pu^{VI} with $NaBrO_3$ and HNO_3, followed by an extraction into ethyl ether using $Ca(NO_3)_2$ as a salting out agent in dilute HNO_3 solution.

H Hydioxide precipitation: Reduction to Pu^{III} with SO_2, followed by precipitation of $Pu(OH)_3$, followed by three or four H_2O washes of the precipitate.

Extraction curves referred to in many of the runs will be found in report LA 404. The method used and the results obtained from all research runs are described in detail in LA 404.

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Run Number[1]	Date Started	Source	Method	Remarks - Purpose Other Than Production
5	2-19-44	Lot 4 (4A)	AEE	Purified material was used for assay, purification, and dry conversion research. Analyses made after AEE. $Na_2Cr_2O_7$ oxidation.
7	3-6-44	Lot 6 (7-A) Lot 2 (4-A)	AAEE	Purified material was used for research. Analyses before and after purification. $Na_2Cr_2O_7$ oxidation.
9	3-20-44	Lot 1 Lot 3 (3-A) Lot 4 (3-A,B,C) Lot 7 (Recovery, R-3, and Metal)	AAEE	Research run. Analyses made after AAEE. $Na_2Cr_2O_7$ oxidation.
12	4-8-44	Lot 10 (10) Lot 11 (11)	AAEEH	Production and research run. Analyses made after AAEE.
14	4-11-44	Lot 13 (12-A,B)	AAEEH	Production and research run. Analyses made after AAEE.
16	4-28-44	Lot 15 (13-A,B)	AAEE	Production and research run. Analyses made after AAEE.
18	4-30-44	Lot 17 (Recovery)	AAEE	Production and research run. Analyses made after AAEE.
20	4-30-44	Lot 19 (Recovery)	AAEEH	Production and research run. Analyses made after AAEE.
22	5-6-44	Lot 21 (15-A)	AAEE	Production and research run. Analyses made after AAEE.
24	5-13-44	Lot 23 (Recovery)	AAEE	Production and research run. Analyses made after AAEE.
26	5-16-44	Lot 25 (16-B)	AAEE	Production and research run. Analyses made after AAEE.
28	5-18-44	Lot 27 (Recovery)	AAEE	Production and research run. Analyses made after AAEE.
30	5-18-44	Lot 29 (Recovery)	AAEE	Production and research run. Analyses made after AAEE.
32	5-20-44	Lot 31 (Recovery)	AAEE	Production and research run. Analyses made after AAEE.
34	5-20-44	Lot 33 (17-D) (18-A)	AAEE	Production and research run. Analyses made after AAEE.
39	5-31-44	Lot 5 35 and 37, Purified plus lots 36 and 38	AAEE	Production and research run. Analyses made after AAEE.
41	6-3-44	Lot 40 (16-A)	AAEE	Production and research run. Analyses made after AAEE.
43	6-6-44	Lot 42 (Recovery)	AAEE	Production and research run. Analyses made after AAEE.
45	6-8-44	Lot 44 (Recovery)	AAEE	Production and research run. Analyses made after AAEE.
49-P[4]	6-10-44	48-R[5]	AAEE	Production and research run. Analyses made after AAEE.
52-P	6-14-44	50-R, 51-R	AAEE	Production and research run. Analyses made after AAEE.
54-P	6-15-44	53-R	AAEE	Production and research run. Analyses made after AAEE.

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[redacted] Table [illegible] (cont.)

Run Number[1]	Date Started	Source[2]	[illegible]	Remarks - Purpose Other Than Production
56-P	6-16-44	55-R (51-P Returned)	AAEE	Production and research run. Analyses made after AAEE.
58-P	6-17-44	57-R	AAEE	Production and research run. Analyses made after AAEE.
60-P	6-19-44	59-X[6] (19-B, 20-A)	AAEE	Production and research run. Analyses made after AAEE.
62-P	6-20-44	61-R	AAEE	Production and research run. Analyses made after AAEE.
64-P	6-21-44	63-R	AAEE	Production and research run. Analyses made after AAEE.
66-P	6-27-44	65-R	AAEE	Production and research run. Analyses made after AAEE.
68-P	7-2-44	67-R (66-P with impurities)	O_2AEO$_2$	Research run-in micro-apparatus Impurities added: Li, Be, B, Na, Mg, Al, K, Ca, Fe-2000 ppm; La, Th, U-10,000 ppm.
70-P	6-29-44	69-R	AAEE	Production and research run. Analyses made after AAEE.
72-P	7-?-44	71-R	O_2AAEE	Production and research run. Analyses made after AAEE. O_2 done by Recovery, to remove U.
74-P	7-4-44	73-R	AAEE	Production and research run. Analyses made after AAEE.
76-P	7-4-44	75-X (21-A, 22-A)	AAEE	Production and research run. Analyses made after AAEE.
78-P	7-5-44	77-C (70-P, 72-P, 74-P, 76-P)	O_2	Production and research run. Analyses made after AAEE.
80-P	7-5-44	79-R	AAEEO$_2$	Production and research run. Analyses made after AAEE.
82-P	7-6-44	81-R	AAEEO$_2$	Production and research run. Analyses made after AAEE.
84-P	7-8-44	83-R (78-P, 80-P, 82-P)	-----	This run was made to prepare 16.638 gm. of Pu as $Pu_2(C_2O_4)_3$.
86-P	7-11-44	85-R	AAEEO$_2$	Production and research run. Analyses made after AAEE.
88-P	7-13-44	87-X (17-A)	AAEO$_2$	Production and research run. Analyses made after AAE.
90-P	7-13-44	89-R	AAEO$_2$	Production and research run. Analyses made after AAE.
92-P	7-17-44	91-R	AAEO$_2$	Production and research run. Analyses made after AAE.
94-P	7-27-44	93-X (26-B)	AEO$_2$	Production and research run. Analyses made after AE.
96-P	7-29-44	95-X	AEO$_2$	Production and research run. Analyses made after AE.
98-P	7-29-44	97-R	AEO$_2$	Production and research run. Analyses made after AE.
100-P	8-1-44	99-R	AEO$_2$	Production and research run.
102-P	8-3-44	101-R	AEO$_2$	Production and research run.
104-P	8-9-44	103-X (27)	AEO$_2$	Production and research run. Analyses made after AE.
106-P	8-9-44	105-R	AEO$_2$	Production and research run. Analyses made after AE.
108-P	8-8-44	103-X (27)	O_2AEO$_2$	This run was made in an enclosed apparatus, on a 1-gram. scale.
110-P	8-9-44	109-R	AEO$_2$	Production and research run.
112-P	8-9-44	111-R	AEO$_2$	Production and research run.
115-P	8-23-44	114-X (28-C)	AEO$_2$	Production and research run.

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TABLE I (Cont.)

Run Number[1]	Date Started	Source[2]	Method	Remarks-Purpose Other Than Production
118-P	8-24-44	119-R	AEO_2	Production and research run.
120-P	8-28-44	119-R	AEO_2	Production and research run.
200-P	9-12-44	200-X (29-A) 200-R	O_1AEO_2	Starting with 200-P, all runs were standardized to the 6-gram scale, until shipments of Hanford material began to arrive.
201-P	9-22-44	201-R	O_1AEO_2	------
202-P	9-26-44	201-X (29-B) 202-X (8-SA)	O_1AEO_2	------
203-P	10-8-44	203-R 204-R	O_1AEO_2	Oxalate wash was added to the $NaPuO_2Ac_3$ precipitate by mistake. Mixture was re-oxidized, and the acetate precipitation repeated.
204-P	10-4-44	203-R	O_1AEO_2	------
205-P	10-10-44	207-X (31-A,32-A, 33-A,5-7A)	O_1AEO_2	Ra-La was added at the beginning of the run, and the stepwise removal of La determined by means of its γ-activity. Acetate precipitation effected the most satisfactory separation in this test.
206-P	10-18-44	205-R 203-X (31-A,32-A, 33-A,5-7A, 3-8A)	O_1AEO_2	The starting material was analyzed, thenthe following impurities were added: Be, Hg-50 ppm.; Mg, Ca-1000 ppm.; Al, Cr, Mn, Tl-2000 ppm. each; Co, Ni, Cd, Zr, Th-5000 ppm. each; Fe, Zn, Cs, Pb-10,000 ppm. each; La-25,500 ppm., 500 ppm. of which was Ra-La. Satisfactory purification was achieved as indicated by analyses after O_1, O_1A, and O_1AE.
207-P	10-17-44	205-R 206-R	EO_2	Impurities as for 206-P except Ra-La. (See above) Analyses made after E. Satisfactory purification was achieved.
208-P	10-18-44	206-R 207-R	O_1AEO_2	Analysis made after O_1AE.
209-P	10-23-44	204-X (34-C) 205-X (34-D) 206-X (26-A) 207-R	O_1AEO_2	Analysis made after O_1AE.
210-P	10-25-44	207-R 208-R	-----	Returned to Recovery--insufficient H^+ for initial reduction.
211-P	10-26-44	209-R	O_1AEO_2	Analysis made after O_1AE.
212-P	11-1-44	207-X (36-A)	O_1AEO_2	------
213-P	11-4-44	209-R 210-R	O_1AEO_2	------
214-P	11-7-44	208-X (35-A, 35-B)	O_1AEO_2	Source material was exposed to stainless steel for 6 days. Analysis made before O_1. Zr-Cb(γ-active), was added, and γ-activity measured after each step. Acetate precipitation effected best separation of Zr-cb is present in tracer quantities. Over-all satisfactory purification was achieved.
215-P	11-14-44	208-X 210-R 211-R 211-X (40-B)	O_1AEO_2	γ-active Zr-Cb added plus Zr-cb carrier. γ-activity measured after each step. Oxalate effected best separation of Zr-cb if present in carrier quantities. Over-all satisfactory purification was achieved.
216-P	11-16-44	211-X 212-X (41-A)	O_1AEO_2	------

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TABLE I (Cont.) [redacted]

Run Number[1]	Date Started	Source[2]	Method[3]	Remarks-Purpose Other Than Production
217-P	11-17-44	212-R	EO_1EO_2	First E was unsatisfactory in removal of Zr-Cb, present as γ-active tracers.
218-P	11-21-44	212-X (41-A) 212-R	O_1AEO_2	------
219-P	11-23-44	212-R 213-X (42-A)	-----	Returned to Recovery--insufficient F^+ for initial reduction.
220-P	11-23-44	209-X 210-X (39-A, 40-A)	O_1AEO_2	γ -activity of source material was followed through the process. Negligible γ-activity left after purification.
221-P	11-24-44	209-X 210-X 213-X (42-A)	O_1AEO_2	γ -activity of source material was followed through the process. Negligible γ-activity left after purification.
222-P	11-27-44	214-R	EO_1AEO_2	Zr, Cb added initially. Analyses made after E and EO_1AE. Satisfactory purification was achieved.
223-P	12-1-44	213-R 214-R 215-R	O_1AEO_2	Analysis made after O_1AE. PuO_2^{++} solution was accurately titrated with NaAc-$NaNO_3$ to the precipitation of $NaPuO_2Ac_3$.
224-P	12-5-44	215-R	O_1AEO_2	------
225-P	12-6-44	215-R 214-X (43)	O_1AEO_2	------
226-P	12-7-44	214-X (43)	O_1AEO_2	PuO_2^{++} solution was accurately titrated with NaAc-NO_3 to the precipitation of $NaPuO_2Ac_3$. Ether "splurfed".
227-P	12-11-44	216-R	O_1AEO_2	PuO_2^{++} solution accurately titrated with NaAc-$NaNO_3$ to the precipitation of $NaPuO_2Ac_3$. Impurities added before purification: 1000 ppm. Fe , 10,000 ppm. Mg, Ca, Sr, La, Al. Analysis made after O_1AE. Purification was satisfactory.
228-P	12-13-44	216-R	EO_2	Impurities added as in 227-P. Analysis made after E. Purification was satisfactory.
229-P	12-16-44	216-R 217-R	O_1AEO_2	Impurities added before purification: 1000 ppm. of Cd, Mg, Pb, Al, Ca; 5000 ppm. of Zn. Analysis made after O_1AE. Purification was satisfactory.
230-P	12-18-44	216-R 217-R	EO_2	Impurities added as in 229-P. Analysis after E. Purification was satisfactory.
231-P	1-2-45	219-R	O_1AEO_2	PuO_2^{++} solution accurately titrated with NaAc-$NaNO_3$ to the precipitation of $Na\ PuO_2Ac_3$. Impurities added before purification: 2000 ppm. of Mn, Ca; 5000 ppm. of Cr, Ni; 20,000 ppm. of U. Analysis made after O_1AE. Purification was satisfactory.
232-P	1-8-45	231-P	EO_2	Added impurities as in 231-P. Analysis made after E and after EO_2. Satisfactory purification.
233-P	1-19-45	214-X (47-X) 220-R	O_1AEO_2	------
234-P	1-20-45	220-R 221-R	O_1AEO_2	$NaPuO_2Ac_3$ precipitate was not washed. Satisfactory purification.
235-P	1-22-45	220-R 221-X (46-A) 222-X (46-A)	O_1AEO_2	------
236-P	1-26-45	222-R	O_1	Used $K_2C_2O_4$ for O_1. Ppt. obtained was very poor, would not oxidize. Returned to recovery.

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TABLE I (Cont.)

Run Number[1]	Date Started	Source[2]	Method[3]	Remarks-Purpose Other Than Production
237-P	2-2-45	223-R	O_1EO_2	Used $K_2C_2O_4$ for satisfactory O_1.
238-P	2-6-45	224-R	O_1EO_2	Used $K_2C_2O_4$ for satisfactory O_1.
239-P	2-12-45	1-W	O_1AEO_2	Analysis made after O_1AE.
240-P	2-13-45	1-W	O_1AEO_2	------
241-P	2-14-45	1-W	O_1AEO_2	------
242-P	2-15-45	1-W	$O_1EO_2EO_2$	Impurities added before purification: 1000 ppm. of Cd, Cr, Fe, Pb; 40,000 ppm. of U. Analysis for U made after O_1E, analysis for other impurities after E. This procedure was repeated, adding above impurities again after O_1E. Satisfactory purification.
243-P	2-18-45	1-W	O_1AEO_2	Impurities added before purification: 10,000 ppm of Li; 50,000 ppm. of Na and K. Analysis made after O_1AE. Extraction curve data was obtained. Satisfactory Purification.
244-P	2-20-45	1-W	O_1AEO_2	Extraction curve made.
245-P	2-21-45	1-W	O_1EO_2	Extraction curve made. Analysis after O_1E.
246-P	2-22-45	1-W	O_1EO_2	Extraction curve made. Plutonium stock solution exposed to [illegible] before purification (See LA - 408 for corrosion data). Analysis after O_1E. Satisfactory purification.
247-P	2-24-45	225-R	O_1AEO_2	Used $K_2C_2O_4$ for satisfactory O_1.
248-P	2-26-45	224-7-X (49-A, 50-A, 51-A, 52-A)	O_1AEO_2	All supernatants and washes kept separate for assay of Pu loss.
249-P	2-27-45	224-7-X (49-A, 50-A, 51-A, 52-A)	O_1AEO_2	Extraction curve made. All supernatants and washes kept separate for assay of Pu loss.
250-P	2-28-45	227-R	O_1AEO_2	Extraction curve made. All supernatants and washes kept separate for assay of Pu loss.
251-P	3-1-45	227-R	O_1AEO_2	Extraction curve made. All supernatants and washes kept separate for assay of Pu loss.
252-P	3-2-45	225-R 227-R	O_1AEO_2	------
253-P	3-4-45	224-4-7X (49-A, 50-A, 51-A, 52-A) 226-R	O_1AEO_2	------
254-P	3-5-45	226-R	O_1AEO_2	------
255-P	3-6-45	228-R	O_1CO_2	Extraction curve made. Analysis for Ca after O_1C.
256-P	3-7-45	228-R	O_1CO_2	Extraction curve made. Analysis for Ca after O_1C.
257-P	3-9-45	224-7-X (49-A, 50-A, 51-A, 52-A)	O_1AEO_2E	Run made to prepare stock solution of super-pure Clinton plutonium as a Pu (IV)- Pu (VI) mixture in dilute (~1 M.) HNO_3.
258-P	3-13-45	1-W	O_1CO_2	8 mg. Ca^{++} added just before O_2 to determine effect on dry conversion and reduction. No apparent effect on dry conversion. Apparently lowered reduction yield at least 2% from average and gave a "messy" reduction.
259-P	3-13-45	229-R	CO_2	Extraction curve made. NH_4I used satisfactorily for last reduction.
260-P	3-12-45	229-R	O_1	Unsatisfactory oxidation. Ret. to recovery.

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TABLE I (Cont.)

Run Number[1]	Date Started	Source[2]	Method[3]	Remarks-Purpose Other Than Production
261-P	3-13-45	229-R	-----	Could not obtain satisfactory O_1 due to presence of peroxide in 229-R. Return to recovery.
262-P	3-26-45	229-R	-----	Could not obtain satisfactory O_1 due to presence of peroxide in 229-R. Return to recovery.
263-P	3-27-45	231-R	CO_2	Extraction curve made. Extra wash on O_2 still didn't remove I_2 color in ppt. Dry conversion and reduction was satisfactory.
264-P	3-28-45	231-R	CO_2	Extraction curve made.
265-P	3-29-45	231-R	CO_2	Extraction curve made. Five H_2O washes used on O_2- no peptization occurred.
266-P	3-30-45	4-W	O_1AEO_2A EO_2AEO_2	Preparation of super-pure Hanford Pu (IV)-Pu(VI) mixture in 1M HNO_3. Analysis before last O_2.
267-P	4-5-45	4-W	CO_2	-------
268-P	4-[illegible]-45	233-R	CO_2	Added Na_2SO_3 instead of $Ca(NO_3)_2$ for extraction. Returned to recovery.
269-P	5-8-45	10-W	O_2	Test effect of SiO_2 on single oxalate pptn. Determine if O_2 constitues satisfactory purification if used on production basis. Results indicated necessity for more purification than O_2.
270-P	5-8-45	10-W	O_2	Test effect of SiO_2 on single oxalate pptn. purification if used on production basis. Results indicated necessity for more purification than O_2.
271-P	5-8-45	10-W	O_2	SiO_2 removed before O_2. Used as control against 269-P and 270-P.
272-P	5-8-45	10-W	O_2	SiO_2 removed before O_2. Used as control against 269-P and 270-P.
273-P*	7-[illegible]-45	21-W	C	Test purification efficiency of $Ca(NO_3)_2$ extraction. Impurities added before C: Fe, La: 20,000 ppm; Cr, Ni, Sn=5000 ppm; SO_4^{-2}= 182,000 ppm; PO_4^{-3}=900 ppm. Analysis after C.
274-P*	7-[illegible]-45	21-W	C	Same as 273-P (control run).
275-P	7-6-45	21-W	C	Same as 273-P except that SO_4^{-2}=500,000 ppm. and PO_4^{-3}=5000 ppm. before C.
276-P*	7-6-45	21-W	C	Same as 275-P (control run)
277-P*	7-6-45	21-W	C	Same as 273-P except that SO_4^{-2}=500,000 ppm. and PO_4^{-3}=20,000 ppm. before C.
278-P*	7-9-45	21-W	C	Same as 277-P (control run)
279-P*	7-9-45	21-W	C	Same as 273-P except that PO_4^{-3} =20,000 ppm. before C.

* These last seven runs were made, specifically, as a check on the "B" Process for complete purification of Pu. Extraction alone removed all elements present below the amount which the subsequent oxalate pptn. could handle (even though some impurities were far in excess of the amount expected from Hanford). Excess SO_4^{-2} had no bad complexing effects on the extraction in addition to being removed nearly completely by the single extraction. The "B" Process (steps "CO_2") was adopted for use on the 160 g. scale shortly afterwards.

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TABLE I-A

Summary of Purification Runs on the 160-gram Scale

Notes on the Headings

1. Each batch of material which entered the purification process was assigned a number, followed by the letter "P." Lot numbers 500-P to 705-P inclusive were all of the order of 160 grams.

2. Each batch of material received from Recovery (at this site). Clinton, and Hanford was assigned a number, followed by a letter indicating the source: "X" denotes Clinton material; "W" denotes Hanford material, when the batch was of the order of 80 grams; "H" denotes Hanford material, when the batch was of the order of 160 grams; "R" denotes recovered material.

Clinton lots were assigned numbers starting with 200-X, and recovered lots were assigned numbers beginning with 200-R. Hanford lots through the twenty-sixth lot were assigned numbers, consequtively, from 1-W to 26-W. Starting with the twenty-seventh, Hanford lots were of the order of 160 grams and were consequently known as "H" lots.

3 For a complete explanation of the processes, see report LA 405.

4 The amount purified is the weight of metallic Pu in the PuO_2 obtained from each "P" lot.

5 A loss $= \frac{P}{O + \Sigma P} \times 100$, where P = the weight, in grams, in a given residue,
O = the weight, in grams, of the amount purified for the "P" lot involved,
ΣP = the sum of all the residue weights, in grams, for that particular "P" lot.

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For the "A" procedures;

P-1 denotes the supernatant and washes from the first $Pu_2(C_2O_4)_3$ precipitation.

P-2 denotes the supernatant and washes from the $NaPuO_2Ac_3$ precipitation.

P-3 denotes the residue from the ethyl ether extraction.

P-4 denotes the supernatant and washes from the second $Pu_2(C_2O_4)_3$ precipitation

P-4-A denotes the supernatant and first wash from the second $Pu_2(C_2O_4)_3$ precipitation.

P-4-B denotes the second and third washes from the second $Pu_2(C_2O_4)_3$ precipitation.

P-6 denotes the residue obtained from washing the boiler after the transfer of the second $Pu_2(C_2O_4)_3$ precipitate.

P-146 denotes the combined residues of P-1, P-4, and P-6.

For the "B" procedures;

P-1 denotes the residue from the ethyl ether extraction.

P-2 denotes the residue obtained from washing the reagent reservoir and extractor after the extraction.

P-3 denotes the supernatant and washes from the $Pu_2(C_2O_4)_3$ precipitation.

For the "C" procedures;

P-4 denotes the residue and washes from the $Pu_2(C_2O_4)_3$ precipitation.

P-6 denotes the residue obtained from washing the boiler after the transfer of the $Pu_2(C_2O_4)_3$ precipitate.

P-46 denotes the combined residues of P-4 and P-6.

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For all procedures;

P-8 denotes the material left in the transfer bottle by "Dry Conversion," and as such, is not a true Purification loss.

P-10 denotes residues obtained through errors and accidents.

6 $A \cong \frac{O}{O + \Sigma P} \times 100$, where $O \cong$ the weight in grams of the amount purified.

$\Sigma P \cong$ the sum of all the residue weights, in grams, for the particular "P" lot.

$B \cong \frac{O}{C.T.} \times 100$, where $O \cong$ the weight in grams of the amount purified,

$C.T. \cong$ the weight in grams of the material initially introduced, for the particular "P" lot, as determined by chemical titration assay.

[redacted]

Lot Number[1]	Date Started	Source[2]	Method[3]	Process Time (Hours)	Apparatus Number	Amount[4] Purified (Grams)	Losses (%)[5] 1	146	2	3	4	4-A	4-B	6	8	10	Yield (%)[6] A	B
500-P	1-2-45	215-X[a] 216-X 217-X 218-X 219-X 220-X 218-R 219-R	A-1	24	3	152.414	.71		1.27	.96		.92	.06	.72			95.4	
501-P	3-13-45	2-W 3-W	A-1	20.5	3	140.655	.40		1.15	2.94		.38	.05			1.12	94.0	
502-P	3-23-45	250-R	A-1	17	5	146.856	.30		1.47	.35		.55	.52				96.6	
503-P	4-3-45	4-W 5-W 252-R	A-1	18	5	146.543	.37		2.62	2.93		.51	.27	.10	.18		96.6	
504-P	4-9-45	6-W 8-W	A-1	18	5	128.420	.49		13.84	1.33		.30	.07	.14			84.0	84.2
505-P	4-11-45	254-R	A-1	16	5	157.513	.18		1.41	.16		1.12	.02	.14			96.9	95.0
506-P	4-16-45	9-W 255-R	A-1	18.5	5	162.645	.44		1.16	2.02							---[b]	---
507-P	4-25-45	256-R 257-R	A-1	18	5	148.148	.71		1.36	.76		1.22	.03	.10	4.18	4.88	87.6	89.1
508-P	4-26-45	259-R 241-R	A-1	17	5	161.149	.24		1.25	.76		.41	.03	.13			97.2	105.3
509-P	4-27-45	258-R 240-R	A-1	14	5	161.207	.28		1.42	.67		.41	.03	.06	.27		96.9	97.6
510-P	4-30-45	11-W 12-W	A-2	15	5	128.282		8.67	2.00	.74							88.4	87.9
511-P	5-6-45	13-W 14-W	A-2	16	5	141.435		.93	1.40	.57							97.7	97.1
512-P	5-7-45	15-W 16-W	A-2	17	5	0.0[c]		4.49	1.66	1.46							---	---
513-P	5-8-45	17-W 18-W	A-2	18	5	134.817		1.06	10.61	1.21							86.8	86.8[d]
514-P	5-9-45	19-W 20-W	A-2	16	5	146.523		.99	1.29	.61					.94		96.2	95.4
515-P	5-10-45	22-W 23-W	A-2	18	5	148.247		1.23	2.34	.49					.66		95.3	95.4
516-P	5-11-45	24-W 25-W	A-2	14.25	5	133.360		7.33	1.97	.44					.70		95.1	86.0
517-P	5-13-45	26-W 242-R	A-2	16	5	165.842		.97	1.44	.62							96.3	99.2
518-P	5-14-45	245-R 244-R	A-2	17	5	142.226		.88	2.24	.08					5.35		91.6	94.1
519-P	5-15-45	27-R	A-3	30.75	5	156.720		1.57	1.01	.34					.27		97.0	96.5
520-P	5-17-45	28-R	A-4	18.5	5	59.282[e]		30.35	1.04	.39					.34		37.4	37.1
521-P	5-17-45	29-R	A-4	15	6	143.839		1.43	1.62	1.56					.88		94.5	---[f]
522-P	5-17-45	30-R	A-4	16.5	5	149.735		.92	1.58	.20					1.07		96.2	---[f]
523-P	5-18-45	31-R	A-4	15.25	6	134.136		.59	11.48	7.27					.11		82.0	88.6
524-P	5-18-45	32-R	A-4	15.3	5	149.557		.57	1.40	7.43					.40		90.7	95.3
525-P	5-21-45	33-R	A-4	15.75	5	145.238		2.11	1.45	.18					1.97		94.3	95.3
526-P	5-21-45	34-R	A-4	16	6	150.690		1.27	1.29	.59					.64		96.2	96.2
527-P	5-22-45	35-R	A-4	16	5	154.406		.89	1.34	.45					.41		96.9	96.0
528-P	5-22-45	36-R	A-4	15	5	145.390		1.20	1.76						.05		94.0	94.6

Lot Number	Date Started	Source	Method	Process Time (Hours)	Apparatus Number	Amount Purified (Grams)	Losses (%)									Yield (%)	
							1	1&2	2	3	4	4-A	4-B	6	8	10	A	B
529-P	5-23-45	37-H	A-4	19.3	5	150.095		1.07	1.44	6.74					.60		91.4	97.7
530-P	5-23-45	38-H	A-4	15.75	6	131.809		2.06	1.31	.39					.60		95.8	85.7
531-P	5-23-45	39-H	A-4	17.25	5	150.183		1.31	.97	.47					.32		97.2	96.5
532-P	5-23-45	41-H	A-4	17	6	150.024		1.88	1.11	.68					.23		96.2	97.7
533-P	5-24-45	40-H	A-4	17	5	148.156		.92	1.30	.61					.31		96.9	---[f]
534-P	5-24-45	246-R	A-4	17	6	168.312		2.17	.99	.30					.55		96.0	---[f]
535-P	5-27-45	42-H	A-4	21[g]	6	138.184		3.19	3.26	1.87					.20		91.8	92.6
536-P	5-27-45	43-H	A-4	21.5[h]	7	138.254		4.42	2.45	1.87					.24	.05	91.3	91.9
537-P	5-28-45	44-H	A-4	16.75	6	111.949		7.02	.21	3.02					1.14		86.6	73.4
538-P	5-28-45	45-H	A-4	18.5	7	97.090		7.00	1.20	.98					.22	1.13	85.6	82.6
539-P	5-29-45	46-H	A-4	17.5	6	145.405		1.03	1.41	.17					.28		97.0	94.2
540-P	5-29-45	47-H	A-4	18.5	7	123.706		2.22	1.56	1.52					.57		93.5	81.7
541-H	5-30-45	48-H	A-4	17.5	6	119.457[i]		1.98	2.48	.17					3.22		91.0	77.2
542-P	5-30-45	49-H	A-4	17.5[j]	7	124.975		3.37	1.37	.53					.22		93.5	81.3
543-P	5-30-45	50-H	A-4	16.7	6	143.308		2.02	1.90	.28					.11		95.7	95.1
544-P	5-31-45	51-H	A-4	17	7	148.407		1.18	1.29	.31					.32		96.6	96.6
545-P	5-31-45	52-H	A-4	15.5	7	136.983		2.11	1.46	.42					.98		94.4	92.4
546-P	5-31-45	247-R	A-4	16	5	138.789		1.81	1.31	.28					2.92		93.6	92.2
547-P	6-1-45	53-H	A-4	15.75	5	139.677		1.84	1.14	.55					1.59		94.9	94.6
548-P	6-1-45	246-R	A-4	15.25	7	128.203		17.88	1.81	.28					.63		81.4	90.2
549-P	6-3-45	54-H	A-4	16.5	5	146.255		.92	1.05	.42					1.64		96.0	96.7
550-P	6-3-45	55-H	A-4	16	7	129.024		5.40	1.23	.53					1.09		91.0	83.3
551-P	6-5-45	56-H	A-4	15.5	5	145.676	.17		1.52	.93	2.88			1.18	.27		93.4	95.7
552-P	6-5-45	57-H	A-4	17	7	114.155	.17		2.31	.48	7.07			14.29	.82		74.9	74.8
553-P	6-6-45	58-H	A-4	15.5	5	157.271	.72[k]		1.25	4.71				.03	.12		93.0	91.4
554-P	6-6-45	59-H	A-4	15.75	7	150.911	1.24[k]		1.62	.24				3.64	.34		93.3	98.9
555-P	6-6-45	248-R	A-4	19	5	142.880		.99	1.45	1.21					.60		95.7	94.7
556-P	6-7-45	60-H	A-4	20	5	144.270		.94	.83	1.60					.88		95.5	94.8
557-P	6-7-45	61-H	A-4	17	6	136.576		1.71	2.14	.18					.47		95.2	88.9
558-P	6-8-45	62-H	A-4	16.25	5	138.162		2.06	1.43	1.57					2.15		93.3	91.7
559-P	6-8-45	63-H	A-4	16.5	6	153.256		1.59	1.51	.14					.12		96.7	97.2
560-P	6-11-45	64-H	A-4	17.5	5	144.690		1.13	1.35	2.40					.99		93.7	95.1
561-P	6-11-45	65-H	A-4	15.25	6	146.916		.86	1.17	.76					.30		96.9	96.1
562-P	6-12-45	66-H	A-4	14.75	6	137.611		5.04	1.53	.75					1.32		91.2	89.8
563-P	6-12-45	66-H	A-4	17.75	5	142.766		1.42	1.41	2.15					2.42		92.6	92.7
564-P	6-13-45	67-H	A-5	17.5	5	131.899		3.72	1.00	2.50					.62		91.6	85.4
565-P	6-13-45	249-R	A-5	15.5	6	141.959		1.37	1.38	1.55					1.18		94.4	92.4
566-P	6-13-45	250-R	A-7	24.75	5	113.817		6.28	1.17	.77					3.01	1.21	85.2	71.4
567-P	6-13-45	251-R	A-7	19.75	6	156.731		1.40	.38	.32					.15		97.7	94.0
568-P	6-14-45	252-R	A-7	16.25	6	152.174		4.25	1.09	.32					.99		93.2	91.4
569-P	6-14-45	253-R	A-7	17.75	7	126.131		2.56	7.88	.28					1.29		87.4	83.1

TABLE XXA (Cont'd.)

Lot Number	Date Started	Source	Method	Process Time (Hours)	Apparatus Number	Amount Purified (Grams)	Losses (%)									Yield (%)	
							1	1&2	2	3	4	4-A	4-B	6	8	10	A	B
570-P	6-15-45	73-H	C-1	4	5	144.802		[a]2.06							1.18		96.9	98.8
571-P	6-16-45	74-H	C-1	3.75	7	89.596		[b]27.92							1.72		68.7	68.6
572-P	6-18-45	69-H	A-6	16.25	7	130.171		5.40	1.80	.32					6.41		86.0	85.8
573-P	6-18-45	70-H	A-7	22.75	8	130.579		3.38	2.27	1.45					.53	.02	91.9	86.6
574-P	6-19-45	71-H	A-7	22.5	7	140.092	.13		1.70	.22	.45			.17	5.18		94.1	93.8
575-P	6-19-45	72-H	A-7	---	5	0.0[n]												0.0
576-P	6-18-45	75-H	B-1	10	6	150.647	[o]											98.9
577-P	6-21-45	76-H	B-1	11.5	5	146.199	[o]											98.9
578-P	6-20-45	254-R	A-7	18	8	83.919		8.61	1.39	1.04							83.8	57.2[p]
579-P	6-21-45	255-R	A-7	21	7	130.187		3.43	1.67	.49					.28		94.4	94.8
580-P	6-21-45	256-R	A-7	17.25	8	104.851		4.40	1.38	3.01					6.16		82.8	71.9
581-P	6-22-45	77-H	A-5	18.7	7	147.821		1.57	1.51	.24							96.7	98.0
582-P	6-22-45	78-H	A-5	16	8	145.059		2.70	2.06	.97					.50		93.9	95.7
583-P	6-24-45	79-H	A-8	19	7	145.060		2.03	1.54	.29							96.2	96.6
584-P	6-24-45	82-H	A-8	22	8	134.072		2.99	1.48	4.45							90.9	88.8[q]
585-P	6-25-45	81-H	A-8	19.5	7	136.705		3.29	1.03	.20							95.7	91.4
586-P	6-25-45	83-H	A-8	25.5	8	139.976		4.47	1.35	2.65							91.6	92.8
587-P	6-26-45	84-H	A-8	18.25	7	144.651		2.46	.27	.94							96.4	96.7
588-P	6-26-45	85-H	A-8	20.7	8	91.061		32.71	1.40	.75							64.3	62.6[r]
589-P	6-27-45	84-H	A-8	22	6	146.724	.43		1.23	.11		.29	.03	.11			97.8	98.3
590-P	6-27-45	87-H	A-8	18	7	139.518		4.19	1.58	.16							94.1	93.6
591-P	6-27-45	88-H	A-8	19.75	8	129.483		4.28	1.02	1.04							93.2	86.2
592-P	6-28-45	89-H	A-9	17.75	7	126.097		2.48	1.29	.33						14.12	82.2	84.0
593-P	6-28-45	90-H	A-9	19	8	142.740		.77	1.24	1.14							96.8	96.2
594-P	6-29-45	91-H	A-9	25.5	6	142.098		[s]										94.9
595-P	6-29-45	80-H	A-8	22.5	7	145.880	.59		1.36	.16	.34			.78			96.8	97.4
596-P	6-29-45	257-R	A-8	---	8 & 6	0.0												0.0[t]
597-P	7-1-45	258-R	A-8	21.75	8	130.680	.24		1.30	2.88	.37			6.12		.01	89.1	88.9
598-P	7-1-45	92-H	A-8	23.5	7	145.685	.37		1.24	.20	.50			.49			97.2	98.2
599-P	7-2-45	93-H	A-8	21.25	5	143.052		1.26	1.68	.59					.32		96.5	97.5
600-P	7-2-45	94-H	A-8	17	6	142.826		.85	2.11	2.32							95.9	98.7
601-P	7-2-45	95-H	A-8	19	7	146.684		1.73	1.16	.13							97.1	99.4
602-P	7-3-45	96-H	A-8	16.75	8	142.050		.96	1.23	1.11							96.7	97.4
603-P	7-3-45	97-H	A-8	19.5	7	139.327		2.71	1.52	.62							95.1	94.6
604-P	7-4-45	98-H	A-8	17.75	7	143.194		2.16	1.02	.11					.25		96.5	96.3
605-P	7-4-45	259-R	A-8	17.75	8	149.094		1.00	1.27	1.47					.69		95.6	95.4
606-P	7-5-45	260-R	A-8	17.75	7	149.792		1.86	1.96	1.35							96.1	98.5
607-P	7-5-45	262-R	A-8	20	8	139.493		1.25	1.25	1.62							95.7	92.6
608-P	7-6-45	261-R	A-8	17	7	161.702		.99	1.29	.16							97.6	98.1
609-P	7-6-45	99-H	A-8	17	8	150.489		1.00	1.57	.52							97.3	109.5[u]
596-1-P	7-6-45	257-R-[illegible]	A-8	17.25	6	144.320		2.50	1.40	1.17							94.8	91.7

This document contains information affecting the national [illegible]

[redacted] TABLE IV-A (Cont.)

Lot Number	Date Started	Source	Method	Process Time (Hours)	Apparatus Number	Amount Purified (Grams)	Losses (%)									Yield (%)	
							1	1&2	2	3	4	4-A	4-B	6	8	10	A	B
610-P	7-10-45	100-H	A-8	17.5	6	146.057		1.25	1.31	.19					.79		96.6	99.2
611-P	7-10-45	102-H	A-8	17	7	155.562		.89	1.42	.34							97.4	98.6
612-P	7-10-45	103-H	A-8	18.5	8	143.115		.89	3.58	.29					.21		95.1	96.8
613-P	7-11-45	101-H	A-8	17	6	148.222		.87	.96	.20					.26		97.7	97.8
614-P	7-11-45	104-H	A-8	17	7	147.692		1.09	1.28	.18							97.6	99.3
615-P	7-11-45	105-H	A-8	17	8	147.077		.95	2.36	.22							96.4	96.3
616-P	7-12-45	264-R	A-8	16	6	151.413		1.82	1.21	.18							96.8	97.4
617-P	7-12-45	106-H	A-8	15.5	7	149.615		1.03	.89	.06							98.0	97.9
618-P	7-12-45	107-H	A-8	16	8	144.363		.92	1.38	.49							97.2	97.3
619-P	7-13-45	108-H	A-8	16.5	6	153.023		1.35	1.46	.19							97.0	98.4
620-P	7-13-45	110-H	A-8	15	7	146.390		1.69	1.28	.16							96.2	96.6
621-P	7-13-45	111-H	A-8	16.5	8	148.667		.67	1.36	.27							97.8	100.4
622-P	7-15-45	263-R	A-8	18.25	6	155.251		.94	1.35	.10						.07	97.5	97.7
623-P	7-15-45	109-H	A-8	19.25	7	144.140		3.02	1.22	.10							95.8	98.1
624-P	7-15-45	112-H	A-8	17	8	142.370		1.57	1.20	.51							96.7	94.8
625-P	7-16-45	113-H	A-8	17.7	7	145.143		1.80	1.03	.17							96.9	96.1
626-P	7-16-45	114-H	A-8	15	8	146.370		.72	1.15	1.05							97.1	99.1
627-P	7-22-45	265-R	A-8	18.75	6	155.271		1.09	1.56	.32							97.1	98.1
628-P	7-22-45	117-H	A-8	16.3	7	143.813		1.13	1.77	.13							97.0	96.2
629-P	7-22-45	120-H	A-8	17	8	136.038		1.17	1.26	.25					2.64		93.3	91.4
630-P	7-23-45	115-H	A-8	23	9	134.629		1.07	1.92	1.65				4.54			91.0	92.9
631-P	7-23-45	116-H	A-9	15	8	147.722		1.33	1.11	.38							97.2	98.2
632-P	7-23-45	118-H	A-9	15.5	7	136.025		1.19	1.34	.47							96.9	92.6
633-P	7-30-45	266-R	B-1	22.5	6	162.360	1.07		.02	1.17							97.8	97.9
634-P	7-30-45	119-H	B-1	11.5	7	161.191	.03		.05	.55							99.4	107.2
635-P	7-30-45	121-H	B-1	12	8	162.024	.02		.01	2.11							97.9	100.7
636-P	7-31-45	122-H	B-1	16.5	9	153.114	.18		.02	1.06							98.8	99.9
637-P	7-31-45	123-H	B-1	10	7	161.644	.02		.02	.50							99.5	100.7
638-P	7-31-45	124-H	B-1	15.25	8	147.846	.05		.01	.56							99.4	97.0
639-P	7-31-45	125-H	B-2	14	6	152.094	1.07		.05	.60							98.3	100.0
640-P	7-31-45	126-H	B-2	11	8	154.702	.04		0W	.46							99.5	102.5
641-P	7-31-45	129-H	B-2	12	6	147.046	.39		0	1.09							98.4	99.6
642-P	8-1-45	130-H	B-2	9	7	148.947	.03		.01	.31							99.7	101.5
643-P	8-1-45	267-R	B-2	10.75	8	133.095	.07		.01	.50							99.4	88.8
644-P	8-1-45	128-H	B-2	11.5	7	145.966	.02		.04	.51							99.4	100.1
645-P	8-1-45	127-H	B-2	9.25	8	166.374	.03		0	.49							99.5	111.8
646-P	8-1-45	268-R	B-2	14.7	6	149.038	.21		0	.59					.24		99.0	99.9
647-P	8-2-45	131-H	B-2	9	7	148.885	.07		0	.67							99.3	99.5
648-P	8-2-45	269-R	B-2	14.5	8	143.363	.04		0	.55					.19		99.2	101.2
649-P	8-2-45	132-H	B-2	11.75	7	149.261	.05		0	.45							99.5	100.0
650-P	8-2-45	133-H	B-2	15	9	143.041	1.64		.03	.51							97.8	94.3

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Lot Number	Date Started	Source	Method	Process Time (Hours)	Apparatus Number	Amount Purified (Grams)	Losses (%)										Yield (%)	
							1	146	2	3	4	4-A	4-B	6	8	10	A	B
651-P	8-3-45	134-H	B-2	10.25	6	146.380	.02		0	.57							99.4	100.6
652-P	8-3-45	135-H	B-2	10/75	7	144.805	.02		0	3.20							96.8	96.6
653-P	8-3-45	137-H	B-2	---[x]	9	0.0											0.0	0.0
654-P	8-3-45	138-H	B-2	10	6	146.705	.03		.08	.52							99.5	100.8
655-P	8-3-45	138-H	B-2	11.75	8	148.523	.09		.01	.78							99.1	99.9
656-P	8-3-45	139-H	B-2	10	7	151.480	.02		0	.48							99.5	100.6
657-P	8-6-45	140-H	B-2	11	6	145.600	2.87		.01	.68							96.5	98.5
658-P	8-6-45	141-H	B-2	11.25	7	147.914	.04		0	1.23							98.7	100.5
659-P	8-6-45	142-H	B-2	14.75	8	121.562	.05		.01	.42							99.4	81.4
660-P	8-6-45	143-H	B-2	11	6	149.307	.05		.01	1.74							98.2	99.4
661-P	8-6-45	144-H	B-2	13.5	7	146.975	.12		.02	1.06							98.8	98.1
662-P	8-6-45	145-H	B-2	10	8	145.962	.05		.01	.52							99.4	99.6
663-P	8-7-45	270-R	B-2	12.25	6	146.538	.10		0	.68							99.2	100.3
664-P	8-7-45	271-R	B-2	18.3	7	154.973	.22		0	.48							99.3	100.0
665-P	8-7-45	146-H	B-2	10.25	6	151.106	.10		.01	.26							99.7	101.2
666-P	8-8-45	148-H	B-2	11	8	149.498	.03		0	.06							99.9	100.2
667-P	8-8-45	147-H	B-2	10.5	5	148.242	.15		0	.94							99.0	100.3
668-P	8-8-45	149-H	B-2	11	7	149.330	.91		.08	.68							98.3	99.1
669-P	8-8-45	150-H	B-2	10.75	6	141.595	.09		.01	.57							99.3	100.6
670-P	8-8-45	151-H	B-2	11.75	8	150.349	.10		0	.44							99.5	100.6
671-P	8-10-45	152-H	B-2	10.75	6	149.966	.04		0	2.09							98.0	102.6
672-P	8-10-45	153-H	B-2	12	7	150.874	.03		0	.53							99.4	100.2
673-P	8-10-45	154-H	B-2	9	8	146.602	.10		.01	.89							99.0	100.1
674-P	8-10-45	155-H	B-2	10	8	149.045	.02		0	1.65							98.4	100.9
675-P	8-10-45	156-H	B-2	9.5	6	145.667	.10		.01	2.28							97.7	102.0
676-P	8-17-45	157-H	B-2[x1]	11.25	?[y]	146.770	.02		.02	.63							99.3	99.8
677-P	8-17-45	158-H	B-2	10.25	?[y]	146.042	.04		0	.49							99.5	99.4
678-P	8-17-45	159-H	B-2	9.5	8	133.054	.33		0	.63							99.0	90.7
679-P	8-20-45	160-H	B-2	9.75	6	148.809	.02		0	.56							99.4	102.3
680-P	8-20-45	161-H	B-2	9.75	7	149.246	.06		0	.53							99.4	104.2
681-P	8-20-45	162-H	B-2	10	8	155.305	.43		0	.63							99.0	106.2
682-P	8-20-45	163-H	B-2	10	7	147.213	.02		0	.43							99.6	99.8
683-P	8-20-45	164-H	B-2	10.3	6	150.621	.02		0	.20							99.8	101.9
684-P	8-20-45	165-H	B-2	17.75	6	143.437	.02		0	.66							99.3	97.2
685-P	8-23-45	166-H	B-2	9.0	?[y]	140.649	.02		0	.29							99.7	99.4
686-P	8-23-45	167-H	B-2	9.5	7	147.358	.02		0	.42							99.6	99.5
687-P	8-23-45	183-H	B-2	10.25	8	135.340	.02		0	.30							99.7	92.5
688-P	8-24-45	169-H	B-2	25.5	6	150.537	.04		0	.32							99.7	102.7
689-P	8-24-45	168-H	B-2	9.5	7	150.967	.05		.09	.59							99.3	101.2
690-P	8-24-45	170-H	B-2	8.75	8	147.390	.59		.01	.87							98.5	100.8

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[redacted] TABLE I-Ae (Cont.)

Lot Number	Date Started	Source	Method	Process Time (Hours)	Apparatus Number	Amount Purified (Grams)	Losses (%)										Yield (%)	
							1	1&2	2	3	4	4-A	4-B	6	8	10	A	B
691-P	8-24-45	273-R	B-2	25.5	8	147.530	.40		.06	1.88						6.08	92.4	102.4
692-P	8-24-45	171-H	B-2	8.5	7	152.421	.03		0	.56							99.6	100.3
693-P	8-24-45	172-H	B-2	9.5	6	150.537	.15		0	.31							99.6	100.4
694-P	8-27-45	173-H	B-2	10.25	6	148.506	.03		0	.43							99.5	99.1
695-P	8-27-45	174-H	B-2	9	7	148.732	.01		.01	.74							99.2	97.8
696-P	8-27-45	175-H	B-2	11	8	143.549	.02		0	.56							99.4	95.6
697-P	8-27-45	176-H	B-2	8.5	7	153.182	.01		0	.32							99.7	101.9
698-P	8-27-45	177-H	B-2	8	6	150.456	.15		0	.41							99.5	102.4
699-P	8-27-45	179-H	B-2	8	8	145.440	1.96		.04	.48							97.6	101.9
700-P	8-28-45	178-H	B-2	11.25	7	140.915	5.18		.03	.71							93.8	96.5
701-P	8-28-45	180-H	B-2	20.75	6	146.753	.03		0	.47							99.5	101.0
702-P	8-28-45	181-H	B-2	9.5	8	149.199	.03		.01	.55							99.4	101.4
703-P	8-28-45	272-R	B-2	12.75	7	115.794	.12		.13	.76							99.0	100.2
704-P	8-28-45	182-H	B-2	11	8	145.006	.03		.06	1.33							98.6	98.0
705-P	8-29-45	184-H	B-2	11.25	6	150.211	.02		.01	.35							99.9	100.3

SUMMARY

Total Amount of Plutonium Purified	29.16 kg.
Total Number of Purification Runs	207
Total Number of "A" Process Purification Runs	130
Total Number of "B" Process Purification Runs (2 Runs Experimental)	75
Total Number of "C" Process Purification Runs (Experimental)	2
Average Process Time for 128 "A" Process Runs	17.8 hrs.
Average Process Time for 72 "B" Process Runs	11.8 hrs.
Average Process Time for "C" Process Runs	3.9 hrs.
Average A Yield for 128 "A" Process Runs	91.1 %
Average A Yield for 73 "B" Process Runs	97.6 %
Average A Yield for Both "A" and "B" Processes	93.4 %
Average B Yield for 121 "A" Process Runs	89.7 %
Average B Yield for 73 "B" Process Runs	98.4 %
Average B Yield for Both "A" and "B" Processes	93.0 %

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TABLE I-A

Notes

on the Data

a The Clinton material used in 500-P had the following composition:

"Y" Lot No.	"X" Batch No.	"X" Lot No.
215-X	44	44-A
216-X	44	44-B
217-X	45	45-A
218-X	45	45-B
219-X	46	46-A
220-X	47	47-A

No chemical titration assays were performed on any of the preceeding batches.

b This lot was given to Recovery as the $+6$ NO_3^- for experimental use.

c When this lot was delivered to Dry Conversion, it was discovered that the transfer bottle had broken in transit, and the lot was given to Recovery.

d The oxidation was incomplete after three hours.

e Some difficulty was encountered during the oxidation. However, when the last oxalate was being precipitated, apparently the mixture was insufficiently stirred, and the $H_2C_2O_4$ solution not thoroughly mixed with the Pu^{++} solution; hence the high loss in P-146.

f The chemical titration assay of the material initially introduced into the apparatus was in error, and the value obtained was discarded.

g During a cooling cycle, the coolant accidentally escaped from the system, causing a five hour delay.

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h The ethyl ether extraction was run for four hours, and the last oxalate settled to 630 ml, an abnormally high volume.

During the transfer, the stirrer broke, resulting in an inefficient transfer, and a high loss in P-146.

i During the conversion from $Pu_2(C_2O_4)_3$ to PuO_2, the product obtained from 541-P and all succeeding runs was heated to 600°C., instead of 900°C., as heretofore.

j A two-hour delay was incurred for mechanical repairs.

k This residue should be labelled "P-14," a combination of P-1 and P-4.

m This residue should be labelled "P-46."

n A wrong reagent was mistakenly added in place of the acetate precipitating reagent. The run was sent to Recovery.

o No data are available for the residue losses.

P The discrepancy between the two yields can undoubtedly be accounted for by the fact that the residue in P-146 is predominantly the highly insoluble $Pu_2(C_2O_4)_3$. As a result, not all of it can be dissolved and the aliquot which is removed for radio-assay is not truly representative. This would tend to make the "A" yield higher than the "B" yield.

q The $NaPuO_2Ac_3$ precipitate settled to an abnormally high volume of 1000 ml., and the second $Pu_2(C_2O_4)_3$ precipitate settled to an abnormally high volume of 600 ml.

r Apparently, quite a bit of the first $Pu_2(C_2O_4)_3$ precipitate was removed along with the supernatant.

s No data are available for the residue losses.

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t This run was started in Apparatus Number 8, but because of the addition of a wrong reagent in one of the steps, it was given to Recovery. On its return from Recovery, the material was put into Apparatus Number 6. However, a wrong reagent was again added and the material once again was sent to Recovery. On its return from Recovery the second time, the material was run as 596-1-P.

u Although the chemical titration value of starting material indicates a yield greater than 100%, it cannot be discarded. With the system in use after 583-P, the slurry which Dry Conversion failed to transfer was left in the transfer bottle, and the bottle was then used for another run. It is probable, therefore, that an appreciable amount of slurry had been left in the transfer bottle used for 609-P--enough so that when it was finally transferred by Dry Conversion, as 609-P, it raised the apparent yield to 109.5%. This explanation may be applied to any succeeding runs which have "B" yields of more than 100%.

v This residue should be labelled "P-14," a combination of P-1 and P-4.

w For all runs which used the B procedures, a P-2 loss of 0% indicates that the loss was less than .005%.

x During the oxidation, the extractor pot cracked and allowed about half of the product to escape into the circulation system. The entire lot was sent to Recovery.

y The Apparatus Number was not recorded.

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TABLE II

Purity Record of Incoming Clinton Material

Table II is a summary of all impurities, for which we have known analyses, present in Clinton plutonium as received by the purification phase of CM-5. All results are given in parts by weight of the impurity per million parts of plutonium (ppm). All lots omitted from this table have not had any analysis record made on them.

Under the heading "Site Y Lot No" is given the lot number assigned at Los Alamos when the plutonium was received. Under the heading "Site X Lot No." is given the shipment designation made at Clinton. Here the first number indicates the Clinton batch number and the capital letter refers to the Clinton lot number.

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[redacted]BLE II. PURITY RECORD OF CLINTON PLUTONIUM

Site Y Lot No.	2	3	4	6	8	10	11	33	40
Site X Lot No.	4-A	5-A	6-A, 6-B 6-C, 6-D and 6-E	7-A	8-A and 8-B	10	11	17-D and 18-A	16-A
Li	-	-	-	-	-	-	-	-	-
Be	-	-	<10	<21	<20	<20	<20	<20	<20
B	-	-	-	-	-	-	-	-	-
Na	-	-	-	-	-	-	-	-	-
Mg	3340	-	<140	<208	<200	100	100	<20	<20
Al	<3340	5710	<140	<2080	<2000	<200	<200	<200	<200
Ca	<3340	-	<1400	4160	1000	200	600	<100	60
V	-	-	-	-	-	-	-	-	-
Cr	-	-	-	-	-	200	200	<400	<200
Mn	-	-	-	-	-	-	-	-	-
Fe	-	-	-	<2080	<2000	<2000	<200	<200	<400
Co	-	-	-	-	-	-	-	-	-
Ni	-	-	-	-	-	-	-	-	-
Cu	-	-	-	-	-	-	-	-	-
Zn	-	-	-	-	-	-	-	-	-
As	-	-	-	-	-	-	-	-	-
Sr	-	-	-	-	-	-	-	-	-
Zr	<6680	2860	<1400	4160	250,000	2000	2×10^5	<400	$>2 \times 10^5$
Cd	-	-	-	-	-	-	-	-	-
Sn	-	-	-	-	-	-	-	-	-
Sb	-	-	-	-	-	-	-	-	-
Ba	-	-	-	-	-	-	-	-	-
La	33,400	14,300	28,000	2×10^5	13,000	30,000	80,000	2000	60,000
Ce	-	-	<7000	<10,400	<10,000	<10,000	10,000	<2000	<2000
Hg	-	-	-	-	-	-	-	-	-
Pb	-	-	-	-	-	-	-	-	-
Bi	<1670	2860	<1400	31,200	20,000	2000	4000	<200	2000
Th	167,000	5710	<7000	20,800	30,000	<2000	20,000	<1000	-
U	-	-	-	-	-	-	-	-	-

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[redacted] BLE II (Cont.)

Site Y Lot No.	59-X	75-X	87-X	103-X	200-X	201-X 202-X	203-X	204-X
Site X Lot No.	19-B and 20-A	21-A and 21-B	17-A and 74-A	27-A	29-A	29-B and 3-6A	32A,33A 37a,and 38a	34-C
Li	-	-	-	-	-	-	-	-
Be	<20	<20	<10	<2	<10	<10	<10	<0.4
B	-	-	-	-	-	-	-	-
Na	-	-	-	-	-	-	-	-
Mg	<20	<20	<20	<20	<20	<20	400	100
Al	<400	<200	<200	<400	<1000	<400	<200	10
Ca	<20	<20	200	40	-	-	-	1000
V	-	-	-	-	-	<1000	<1000	-
Cr	<200	<400	<200	<400	<2000	<400	<200	1800
Mn	-	-	-	-	-	<400	<400	4
Fe	<400	<400	<800	<1000	-	-	-	15,200
Co	-	-	-	-	-	-	-	<35
Ni	-	-	-	-	-	<1000	<1000	<35
Cu	-	-	-	-	-	-	-	-
Zn	-	-	-	-	-	<2000	<2000	<35
As	-	-	-	-	-	-	-	700
Sr	-	-	-	-	-	-	-	20
Zr	<200	5000	1000	10,000	4000	<1000	1000	-
Cd	-	-	-	-	-	<1000	<400	350
Sn	-	-	-	-	-	<1000	-	100
Sb	-	-	-	-	-	-	-	<35
Ba	-	-	-	-	-	-	-	<35
La	<400	<200	<400	<1000	<2000	<1000	2000	26,000
Ce	<1000	<1000	<400	<2000	<2000	<1000	2000	<35
Hg	-	-	-	-	-	-	-	350
Pb	-	-	-	-	-	-	-	250
Bi	<200	<1000	<400	<400	<4000	<400	<1000	-
Th	<2000	<2000	-	<2000	-	<1000	<2000	-
U	500	500	-	-	-	-	-	<750

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[redacted] TABLE IX (Cont.)

Site Y Lot No.	205-X	206-X	207-X	208-X	209-X 210-X	211-X	212-X	213-X	214-X
Site X Lot No.	34-D	26-A	36-A	35-A and 35-B	39-A and 40-A	40-B	41-A	42-A	43X,43B and 43A
Li	-	-	-	-	-	-	-	-	<4
Be	<0.4	<0.4	<0.3	<0.4	<0.4	<0.5	<0.3	-	<0.4
Na	-	-	-	-	-	-	-	-	170
Mg	<4	7	20	13	29	19	16	800	300
Al	4	4	20	30	54	48	65	100	130
Ca	8	40	180	170	290	48	320	-	2200
V	-	-	<1000	<1000	-	<1000	<1000	-	-
Cr	8	<4	30	23	54	48	65	<200	390
Mn	<4	<4	11	10	29	5	130	-	260
Fe	1925	190	470	1050	840	350	28000	-	3644
Co	<40	<20	<20	<17	<18	<24	<16	-	<22
Ni	<40	<20	<20	<17	54	24	32	-	220
Zn	<80	<40	<40	30	<18	24	<16	-	<44
As	<40	<400	<2000	<300	<300	<2000	<2000	-	-
Sr	<4	<4	0.8	0.6	<4	<5	<3	-	<4
Zr	-	-	2000	2000	1000	<1000	<1000	<200	-
Cd	80	<20	<20	<17	<18	<24	<16	-	<9
Sn	16	<20	150	80	90	140	100	-	150
Sb	<40	<400	<1000	<1000	-	-	<1000	-	-
Ba	<40	<4	8	10	7	4	2	-	130
La	800	4	10000	10000	2000	380	2000	8000	1100
Ce	<40	<40	<40	<30	<36	<24	<16	-	<22
Hg	<400	<400	<400	<300	290	<48	<32	-	<44
Pb	<40	<40	30	80	32	<5	260	<200	130
Bi	-	-	<1000	<1000	-	<2000	<2000	-	-
Th	-	-	<2000	<2000	<2000	6000	6000	<2000	-
U	<400	<400	<2000	<2000	<360	<480	<320	-	<440

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[redacted] E II (Cont.)

Site Y Lot No.	215-8-X	217-X	219-X	220-X	223-X	224-7-X
Site X Lot No.	44-A,44B and 45-B	45A	46A	42A	P-32	49A,50A 51A,52A
Li	-	-	-	-	-	-
Be	<10	<10	<10	<10	<20	<10
B	-	-	-	-	-	-
Na	-	-	-	-	-	-
Mg	20	60	20	40	<20	<100
Al	<200	<200	<200	<200	<200	<400
Ca	-	-	-	-	20	-
V	<1000	<1000	<1000	<1000	<1000	<1000
Cr	200	<200	<200	<200	<200	<1000
Mn	<20	<20	<20	<20	<100	<200
Fe	-	-	-	-	-	-
Co	<2000	<2000	<2000	<2000	<2000	<1000
Ni	<200	<200	<200	<200	<1000	<1000
Cu	-	-	-	-	-	-
Zn	<2000	<2000	<2000	<2000	<1000	<2000
As	-	<2000	<2000	<2000	-	-
Sr	<200	<200	<200	<200	<1000	-
Zr	<1000	<1000	<1000	<1000	<1000	<1000
Cd	<200	<200	<200	<200	<200	<1000
Sn	<1000	15,000	<1000	<1000	<1000	<1000
Sb	<2000	<2000	<2000	<2000	-	-
Ba	400	1000	400	400	<100	-
La	<1000	<1000	<1000	<1000	<200	10,000
Ce	<2000	<2000	<2000	<2000	<2000	<2000
Hg	<2000	<2000	<2000	<2000	<2000	<2000
Pb	1000	20,000	<200	1000	<1000	<1000
Bi	<1000	<1000	<1000	<1000	<1000	<1000
Th	<2000	<2000	<2000	<2000	<2000	<2000
U	<2000	<2000	<2000	<2000	20,000	<2000

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TABLE II-A

Purity of Incoming Material

All elements except S as $SO_4^{=}$, Pu^{VI}, and those listed under "Solids" have been reported as parts per million parts of plutonium. S has been reported as weight per cent of $SO_4^{=}$ to Pu. (For example, 16 grams of $SO_4^{=}$, as determined volumetrically, in an "H" lot of 160 grams of Pu would be reported as 10% $SO_4^{=}$.) The amount of Pu^{VI}, determined spectrophotometrically, has been reported as a per cent of the total amount of Pu present in the lot.

Solids have been reported as the total weight, in milligrams, of centrifugable solid matter, dried to constant weight at 110°-120°C. The constituents under solids were determined spectrochemically and have been reported as per cent of the total solids, of the following compounds.

Element	Compound
Si	$SiO_2 \cdot \frac{1}{2} H_2O$
P	H_3PO_4
Cr	CrO_3
Fe	$Fe(OH)_3$
Zn	ZnO
Sn	$H_2Sn_5O_{11} \cdot 2H_2O$

The marked differences in sensitivities in the reports of an element, as evidenced generally by a comparison of every tenth lot with its neighbors, is caused by different methods of analysis. All elements listed have been

detected by one or more of the following methods: direct copper spark, cupferron spectrochemical procedure, pyro-electric analysis, colorimetric analysis, and flourimetric analysis.

For the direct copper spark results, an HCl solution containing 50γ of Pu is evaporated on copper electrodes and the spark spectrum is then photographed. The quantity of impurities present in the sample is estimated by a comparison of the intensity and width of the impurity lines with corresponding lines of standard spectra, photographed on the same plate. This method reveals the presence of the following elements, with the limits of sensitivity as indicated.

Element	Limit of Sensitivity (ppm)
Li	200
Be	10
Na	200
Mg	20
Al	200
K	2000
Ca	20
V	1000
Cr	400
Mn	400
Co	1000
Ni	1000
Zn	2000
Sr	20
Zr	1000
Cd	1000
Sn	1000
Ba	20
La	1000
Ce	2000
Au	200
Hg	2000
Pb	2000
Bi	1000
Th	2000
U	2000

[redacted]

(In Table II-A, Li, Na, K, and Au, as determined by direct copper spark, have not been reported.)

The cupferron spectrochemical procedure generally yields higher sensitivities for much the same list of elements, because the interfering plutonium is first removed from the sample by extraction of plutonium cupferride with chloroform. The aqueous phase is then evaporated on copper electrodes and a photograph of the spark spectrum is made. The quantitative determination of the impurities is done as in the direct spark analysis, with the following sensitivities.

Element	Limit of Sensitivity (ppm)
Li	2
Be	0.2
Na	2
Mg	2
Al	2
K	20
Ca	10
Cr	2
Mn	2
Co	10
Ni	10
Sr	2
Cd	5
Ba	2
La	2
Ce	20
Pb	10

If any lot had both direct copper spark and cupferron analyses performed on it, the cupferron values have always been reported, except in the case of La, when the direct copper spark value has been used. (This was done because the amount of La present generally was of the order of magnitude of the direct copper spark sensitivity.)

[redacted]

The third method of analysis, which, with the direct copper spark and cupferron analyses, accounts for about 90% of the elements reported, is the pyro-electric analysis. In this method, the sample is mixed with U_3O_8 and $GaCl_3$, placed in a hollow carbon electrode, and an arc is struck. The resulting spectrum is photographed and a quantitative determination of impurities made by a comparison of the impurity lines with corresponding lines of standards, which have been photographed on the same plate. This method yields the following results.

Element	Limit of Sensitivity (ppm)
Si	6
V	300
Cu	30
Ge	6
Ag	$\ll 6$
In	15
Sn	15
Sb	150
Tl	30

P, Fe, and B are determined by colorimetric analyses. For the P determination, after removal of HNO_3, the P is complexed with $(NH_4)_2MoO_4$, the Pu extracted with n-butyl alcohol, and $SnCl_2$ added to form "molybdate blue," the intensity of which is compared to those of a set of standards, for a quantitative determination of P. In the Fe analysis, the Fe is reduced with hydroxylamine, the resulting solution buffered, o-phenanthroline added, and the intensity of the resulting color measured with a Beckman spectrophotometer. Any B present in the "H" lot sample is distilled out with CH_3OH as $B(OCH_3)_3$ into $Ca(OH)_2$, which is then acidified and mixed with curcumin, after which a

cooler comparison is carried out. These analyses result in the following sensitivities.

Element	Limit of Sensitivity (ppm)
B	0.5
Fe	20
P	20

The flourimetric U analysis is performed by dissolving the sample in H_3PO_4, freezing the solution, and exposing the glass to ultra-violet light, with the resulting flourescence compared to those of a set of standards. The limit of sensitivity of this analysis is 100 ppm. If any lot had both a direct copper spark and a flourimetric U analysis performed on it, the result from the latter method has always been reported.

Any S present is reduced to $S^{=}$, acidified, and distilled into $Cd(NO_3)_2$ as H_2S. A measured excess of I_2 is added and the solution is then back titrated with standard $S_2O_3^{=}$. This volumetric analysis has a limit of sensitivity of ~1.5 mg. $SO_4^{=}$.

In any lot which had a "solids" analysis performed on it, the centrifuged solids and the supernatant from the sample were analyzed seperately. Should a report on any element have appeared in both analyses, the two results have been added together, and the sum has been reported above "Solids" in Table II-A

An attempt has been made to include with the impurity data some indication of the irradiation received by the pile material from which each "R" or "H" lot was derived. This has been done in the "Irradiation" column, the

units used being grams of plutonium per metric ton of uranium, as determined by radio-assay. (This is equivalent to parts per million.)

Note" -- For an explanation of lot numbers, see Table I-A, "Notes on the Headings," footnote 2.

	1-W	2-W	3-W	4-W	5-W	6-W	7-W	8-W	9-W	10-W [a]
Irradiation	26.5	37.6	38.8	44.0	53.0	59.5	62.5	64.5	57.0	-[b]
Li	<4	<3	<4	<1.5	<1.6	-	-	-	-	<1
Be	≤0.4	<0.2	<0.2	<0.7	<0.8	<10	<10	<10	<10	<0.1
B	-	-	-	-	-	-	-	-	-	-
Na	100	670	34	230	230	-	-	-	-	28
Mg	100	100	50	120	80	<200	60	<200	<200	12
Al	211	17	10	15	15	<200	<20	<200	<200	16
Si	~1200	85	-	-	-	-	-	-	-	-
P	-	-	-	-	-	-	-	-	-	-
$SO_4^=$	-	-	22.8	21.7	22.8	-	-	-	-	18.6
K	-	2000	<34	750	960	-	-	-	-	≤31
Ca	80	670	340	750	157	300	100	300	<200	470
V	<1000	<1000	<1000	<1000	-	<1000	<1000	<1000	<1000	-
Cr	2100	1000	1700	1500	800	3000	2000	3000	1000	800
Mn	210	330	170	150	125	<400	<200	<400	<400	47
Fe	6250	4250	4600	6000	4650	-	-	5500	5000	10330
Co	<21	<17	<17	<8	<8	<1000	<1000	<1000	<1000	<8
Ni	1250	1000	1400	750	800	<200	1000	<200	4000	470
Cu	-	-	-	-	-	-	-	-	-	-
Zn	83	-	<34	<15	<16	-	-	-	-	<31
As	-	-	-	-	-	<2000	<4000	<2000	<2000	-
Sr	<4	<3	<4	≤2	<1.6	<200	<20	<200	<200	<2
Zr	<2000	1000	<1000	<1000	-	<1000	<1000	<1000	<1000	-
Ag	-	-	-	-	-	-	-	-	-	-
Cd	38	<17	<17	<8	<8	<1000	<1000	<1000	<1000	<8
In	-	-	-	-	-	-	-	-	-	-
Sn	42	<170	-	75	31	<2000	<1000	<2000	<2000	125
Sb	-	-	-	-	-	-	<200	-	-	-
Ba	<4	<3	<4	<0.2	<0.2	<200	<200	<200	<200	<2
La	125	67	70	8	8	<2000	<1000	<2000	<2000	14
Ce	<42	≤33	≤34	<15	<16	<10000	<4000	<10000	<10000	<16
Hg	-	-	<34	-	<16	<4000	<4000	<4000	<4000	<16
Tl	-	-	-	-	-	-	-	-	-	-
Pb	125	330	85	75	63	<1000	<1000	<1000	<1000	110
Bi	<2000	<2000	<2000	<2000	-	<1000	<1000	<1000	<1000	-
Th	~300	-	-	-	-	<4000	<4000	<4000	<4000	-
U	-	<30	<100	<75	<79	<10000	<4000	<10000	<10000	-
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	~600
a. Si	-		-	-	-	-	-	-	-	-
b. Sn	-	-	-	-	-	-	-	-	-	-

Irradiation	11-W	12-W	13-W	14-W	15-W	16-W	17-W	18-W	19-W	20-W
Li	-	-	-	-	-	-	-	-	-	-
Be	<10	<10	<10	<10	<10	<10	<10	<10	≤10	<10
B	-	-	-	-	-	-	-	-	-	-
Na	-	-	-	-	-	-	-	-	-	-
Mg	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Al	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Si	-	-	-	-	-	-	-	-	-	-
P	-	-	-	-	-	-	-	-	-	-
$SO_4^=$	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-
Ca	<200	400	200	300	<200	300	300	400	<200	<200
V	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Cr	4000	4000	3000	4000	3000	1500	4000	3000	4000	4000
Mn	<400	<400	<400	<400	<400	<400	<400	<400	<1000	<1000
Fe	12277	10084	12046	11786	11928	8609	11109	10900	16600	10540
Co	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<2000	<2000
Ni	2000	2000	2000	3000	1000	2000	2000	2000	1000	1500
Cu	-	-	-	-	-	-	-	-	-	-
Zn	-	-	-	-	-	-	-	-	-	-
As	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<2000
Sr	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Zr	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Ag	-	-	-	-	-	-	-	-	-	-
Cd	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
In	-	-	-	-	-	-	-	-	-	-
Sn	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<2000	2000	2000
Sb	-	-	-	-	-	-	-	-	<1000	<1000
Ba	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
La	10000	<2000	6000	6000	<2000	<2000	6000	6000	6000	4000
Ce	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000	-	-
Hg	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<10000	<10000
Tl	-	-	-	-	-	-	-	-	-	-
Pb	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<2000	<2000
Bi	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Th	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<10000	<10000
U	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	~210	-	-	-	-	-	-	-	-	-
a. Si	-	-	-	-	-	-	-	-	-	-
b. Sn	-	-	-	-	-	-	-	-	-	-

[redacted] TABLE II-A (Cont.)

	21-W[a]	22-W	23-W	24-W	25-W	26-W	27-H	28-H	29-H	30-H[a]
Irradiation	-	-	-	-	-	-	-	-	-	-
Li	<1	-	-	-	-	-	-	-	-	<1.5
Be	<0.1	≤10	<10	<10	<10	<10	<10	<10	<12	<0.2
B	-	-	-	-	-	-	-	-	-	-
Na	150	-	-	-	-	-	-	-	-	160
Mg	9	600	<200	<200	<200	<200	<200	150	<25	12
Al	15	200	<200	<200	<200	<200	<200	<20	<250	9
Si	-	-	-	-	-	-	-	-	-	300
P	930	-	-	-	1460	1220	930	830	1130	1690
$SO_4^{=}$	18.2	-	-	-	-	-	-	14	-	26.6
K	190	-	-	-	-	-	-	-	-	800
Ca	56	<200	<200	<200	<200	<200	<200	100	<120	47
V	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1200	<300
Cr	4000	3000	4000	3000	2000	3000	1500	2000	2300	3000
Mn	75	<1000	<1000	<1000	<1000	<1000	<1000	<200	<1200	95
Fe	6060	10185	9830	6985	7260	7700	8815	9500	9450	6950
Co	<9	<2000	<2000	<2000	<2000	<2000	<2000	<1000	<1200	<12
Ni	280	1000	1500	1000	1000	1500	800	2000	<1200	230
Cu	-	-	-	-	-	-	-	-	-	50
Zn	<37	-	-	-	-	-	-	-	-	<47
As	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<4000	<4800	-
Sr	<2	<200	<200	<200	<200	<200	<200	<20	<120	<2
Zr	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1200	-
Ag	-	-	-	-	-	-	-	-	-	-
Cd	<19	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1200	<23
In	-	-	-	-	-	-	-	-	-	<6
Sn	110	2000	2000	1000	1000	2000	1000	<1000	<1200	120
Sb	≤1000	<1000	<1000	<1000	≤1000	<1000	<1000	2000	-	<25
Ba	<2	<200	<200	<200	<200	<200	<200	<200	<120	<2
La	2000	3000	10000	20000	10000	4000	1000	2000	1800	6000
Ce	<19	-	-	-	-	-	-	<4000	<4800	<23
Hg	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<4000	-	-
Tl	-	-	-	-	-	-	-	-	-	<6
Pb	9	<2000	<2000	<2000	<2000	<2000	<2000	<4000	<1200	12
Bi	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<2400	250
Th	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<4000	<4800	-
U	140	<10000	<10000	<10000	<10000	<10000	<10000	<4000	-	100
Pu^{VI}	51.6	-	-	-	-	-	-	-	-	67
Solids	213	-	-	-	-	-	-	-	-	1120
a. Si	-	-	-	-	-	-	-	-	-	-[c]
b. Sn	-	-	-	-	-	-	-	-	-	-[c]

[redacted] II-A (Cont.)

	31-H	32-H	33-H	34-H	35-H	36-H	37-H	38-H	39-H	40-H
Irradiation	-	-	-	-	-	-	-	148	158	157
Li	-	-	-	-	-	-	-	-	-	-
Be	<13	<10	<10	<12	<12	<13	<14	<10	<10	<10
B	-	-	-	-	-	-	-	-	-	-
Na	-	-	-	-	-	-	-	-	-	-
Mg	<25	<20	<20	<25	<25	<25	<30	≤20	<20	≤20
Al	<250	<200	<200	<250	<250	<250	<300	≤200	<200	≤200
Si	-	-	-	-	-	-	-	-	-	-
P	-	-	-	-	-	-	-	-	-	-
$SO_4^=$	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-
Ca	<130	<100	<100	<125	<125	<130	<150	<100	<100	<100
V	<1300	<1000	<1000	<1250	<1200	<1250	<1500	<1000	<1000	<1000
Cr	2000	1600	2000	1850	1500	1500	1800	4000	4000	2000
Mn	<1300	<1000	<1000	<1250	<1200	<1250	<1500	<1000	<1000	<1000
Fe	8220	6850	15300	5850	13300	4310	6400	10800	4720	12400
Co	<1300	<1000	<1000	<1250	<1200	<1250	<1500	<1000	<1000	<1000
Ni	<1300	<1000	<1000	<1250	<1200	<1250	<1500	<1000	<1000	<1000
Cu	-	-	-	-	-	-	-	-	-	-
Zn	-	-	-	-	-	-	-	-	-	-
As	<5000	<4000	<4000	<5000	<5000	<5000	<6000	<10000	<10000	<10000
Sr	<130	<100	<100	<125	<125	<130	<150	<200	<200	<200
Zr	<1300	<1000	<1000	<1250	<1250	<1250	<1500	<1000	<1000	<1000
Ag	-	-	-	-	-	-	-	-	-	-
Cd	<1300	<1000	<1000	<1250	<1250	<1250	<1500	<1000	<1000	<1000
In	-	-	-	-	-	-	-	-	-	-
Sn	<1300	<1000	<1000	<1250	<1250	<1250	<1500	<2000	<2000	<2000
Sb	-	-	-	-	-	-	-	-	-	-
Ba	<130	<100	<100	<125	<125	<130	<1500	<1000	<1000	<1000
La	3700	3000	6000	5000	3800	3800	9000	40000	16000	<2000
Ce	<2500	<2000	<2000	<2500	<2500	<2500	<3000	<4000	<4000	<4000
Hg	-	-	-	-	-	-	-	-	-	-
Tl	-	-	-	-	-	-	-	-	-	-
Pb	<1300	<1000	<1000	<1250	<1250	<1250	<1500	<1000	<1000	<1000
Bi	<2500	<2000	<2000	<2500	<2500	<2500	<3000	<1000	<1000	<1000
Th	<5000	<2000	<4000	<5000	<5000	<5000	<6000	-	<4000	<4000
U	-	-	-	-	-	-	-	-	-	-
Pb^{VI}	-	-	48.7	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	-
a. Si	-	-	-	-	-	-	-	-	-	-
b. Sn	-	-	-	-	-	-	-	-	-	-

[redacted]

	41-H	42-He	43-H	44-H	45-H	46-H	47-H	48-H	49-H	50-H
Irradiation	155	154	149	151	149	146	139	138	140	130
Li	<2	-	-	-	-	-	-	-	-	<2
Be	<0.2	<10	<10	<10	<10	<10	<10	<10	<10	<0.2
B	-	-	-	-	-	-	-	-	-	-
Na	200	-	-	-	-	-	-	-	-	380
Mg	15	<20	<20	≤20	<20	<20	80	<20	<20	15
Al	18	200	<200	≤200	<200	<200	<20	<100	<100	20
Si	250	-	-	-	-	-	-	-	-	200
P	1250	-	-	-	-	-	-	-	-	152
$SO_4^{=}$	-	-	-	-	-	-	-	-	-	-
K	650	-	-	-	-	-	-	-	-	800
Ca	100	<20	<20	<100	<20	<20	1000	<20	<20	64
V	<300	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<300
Cr	2500	4000	4000	≤2000	4000	2000	1800	~2000	<1000	2500
Mn	100	<1000	<1000	<1000	<1000	<1000	-	<1000	<1000	100
Fe	8400	8800	7520	6850	5120	5140	5875	5900	5000	7900
Co	<15	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<15
Ni	500	<1000	≤1000	<1000	≤1000	1000	2000	<200	<200	500
Cu	125	-	-	-	-	-	-	-	-	80
Zn	<50	-	-	-	-	-	-	-	-	<50
As	-	<4000	<4000	<10000	<4000	<4000	<4000	<4000	<4000	<4000
Sr	<2.5	<100	≤100	<200	<100	<100	<20	<100	<100	<2.5
Zr	-	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	-
Ag	-	-	-	-	-	-	-	-	-	-
Cd	<25	<1000	1600	<1000	1600	1600	<1000	<1000	<1000	<25
In	<6	-	-	-	-	-	-	-	-	<6
Sn	150	<2000	<2000	<2000	<2000	<2000	<1000	<2000	<2000	125
Sb	<25	-	-	-	-	-	-	-	-	<25
Ba	<2.5	<200	<200	<1000	<200	<200	<200	<200	<200	<2.5
La	>10000	20000	2000	14000	4000	2000	10000	60000	>10000	>10000
Ce	<25	<4000	<4000	<4000	<4000	<4000	<4000	<2000	<2000	<25
Hg	-	-	-	-	-	-	-	-	-	-
Tl	<6	-	-	-	-	-	-	-	-	<6
Pb	38	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	38
Bi	250	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	500
Th	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000
U	100	-	-	-	-	-	<4000	-	-	100
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-[c]	-	-	-	-	-	-	-	-	-[c]
a. Si	-[c]	-	-	-	-	-	-	-	-	-[c]
b. Sn	-[c]	-	-	-	-	-	-	-	-	-[c]

This document contains information affecting the nation[redacted]
al defense of the United [redacted]
the [redacted]
sion [redacted]
an un[redacted] is prohibited by law.

	51-H	52-H	53-H	54-H	55-H	56-H	57-H	58-H	59-H	60-H
Irradiation	108	140	180	186	186	184	177	186	183	186
Li	-	-	-	-	-	-	-	-	-	<1.3
Be	<10	<10	<10	<10	<10	<10	<10	<15	<10	<0.1
B	-	-	-	-	-	-	-	-	-	-
Na	-	-	-	-	-	-	-	-	-	150
Mg	<20	<20	<20	<20	<20	<20	<20	<30	<20	8
Al	<100	<100	<100	<100	<100	<100	<100	<300	<200	15
Si	-	-	-	-	-	-	-	-	-	3100
P	-	-	-	-	-	-	-	-	-	1020
$SO_4^=$	-	-	-	-	-	-	-	-	-	21.1
K	-	-	-	-	-	-	-	-	-	500
Ca	20	40	40	40	80	140	200	<30	<20	75
V	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1500	<1000	<300
Cr	2000	2000	2000	2000	2000	4000	2000	3000	<1600	2000
Mn	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1500	<1000	23
Fe	6820	13000	5000	8500	5360	6820	5540	4800	3240	3770
Co	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1500	<1000	<13
Ni	<200	<200	<200	<200	<1000	<200	<200	1500	<1000	≈1000
Cu	-	-	-	-	-	-	-	-	-	80
Zn	-	-	-	-	-	-	-	-	-	<50
As	<4000	<4000	<4000	<4000	<4000	<4000	<4000	-	<4000	<4000
Sr	<100	<100	<100	<100	<100	<100	<100	<150	<100	<1.3
Zr	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1500	<1000	-
Ag	-	-	-	-	-	-	-	-	-	-
Cd	<1000	<100	<1000	<1000	<1000	<1000	<1000	<1500	1600	<13
In	-	-	-	-	-	-	-	-	-	<6
Sn	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<3000	<2000	600
Sb	-	-	-	-	-	-	-	-	-	<25
Ba	<200	<200	<200	<200	<200	<200	<200	<300	<200	<13
La	>10000	40000	6000	>10000	>10000	40000	40000	3000	<2000	6000
Ce	<2000	<2000	<2000	<2000	<2000	<2000	<200	<6000	<4000	<25
Hg	-	-	-	-	-	-	-	-	-	<50
Tl	-	-	-	-	-	-	-	-	-	<6
Pb	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1500	<1000	25
Bi	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	250
Th	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<6000	<4000	-
U	-	-	-	-	-	-	-	-	-	100
PuVI	-	-	-	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	221
a. Si	-	-	-	-	-	-	-	-	-	17
b. Sn	-	-	-	-	-	-	-	-	-	46
c. P	-	-	-	-	-	-	-	-	-	27
d. Fe	-	-	-	-	-	-	-	-	-	10

[redacted]

[redacted] TABLE II-A (Cont.)

	61-H	62-H	63-H	64-H	65-H	66-H	67-H	68-H	69-H	70-H
Irradiation	195	179	184	179	164	156	184	156	186	187
Li	-	-	-	-	-	-	-	-	-	-
Be	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
B	-	-	-	-	-	-	-	-	-	-
Na	-	-	-	-	-	-	-	-	-	-
Mg	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Al	<200	<200	200	<200	<200	<200	<200	<200	<100	<200
Si	-	-	-	-	-	-	-	-	-	-
P	-	-	-	-	-	-	-	-	-	-
$SO_4^{=}$	-	-	-	-	-	-	-	-	-	-
K	-	-	-	-	-	-	-	-	-	-
Ca	<20	<20	<20	<20	<20	-	-	-	80	-
V	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Cr	2000	1000	4000	2000	2000	4000	2000	1600	8000	4000
Mn	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Fe	4720	6130	9170	5360	5130	4900	5100	4530	7480	5980
Co	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Ni	<1000	2000	<1000	-	3000	8000	2000	2000	<200	<1000
Cu	-	-	-	-	-	-	-	-	-	-
Zn	-	-	-	-	-	-	-	-	-	-
As	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000
Sr	<100	<100	<100	<100	<100	<100	400	<100	<1000	<100
Zr	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Ag	-	-	-	-	-	-	-	-	-	-
Cd	1000	1000	1000	1000	2100	<200	<2000	<2000	<1000	<2000
In	-	-	-	-	-	-	-	-	-	-
Sn	<2000	<2000	<2000	<2000	<2000	<1000	<1000	<1000	<2000	<1000
Sb	-	-	-	-	-	-	-	-	-	-
Ba	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
La	60000	20000	<1000	2000	2000	<2000	<2000	<2000	32000	40000
Ce	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<2000	<4000
Hg	-	-	-	-	-	-	-	-	-	-
Tl	-	-	-	-	-	-	-	-	-	-
Pb	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<4000
Bi	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Th	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	-
a. Si	-	-	-	-	-	-	-	-	-	-
b. Sn	-	-	-	-	-	-	-	-	-	-

[redacted] ABLE II-A (Cont.)

	71-H	72-H	73-H	74-H	75-H	76-H	77-H	78-H	79-H	80-H
Irradiation	180	173	172	198	186	177	187	196	203	206
Li	<1	-	<1	<1	<1.2	<1.2	-	-	-	-
Be	<0.1	-	<0.1	<0.1	<0.1	<0.1	<10	<10	<10	<10
B	<1	-	1.4	2.7	1.2	2	-	-	-	-
Na	200	-	170	140	180	140	-	-	-	-
Mg	2.5	-	2	2.5	2.5	2.4	≤20	≤20	≤20	≤20
Al	7	-	11	10	15	12	<20	<20	<20	<200
Si	340	-	-	<250	790	<120	-	-	-	-
P	980	-	1185	1260	1100	1320	1215	1175	1175	940
$SO_4^{=}$	21.9	-	20.9	17.4	19.6	21.4	-	-	-	-
K	~600	-	~450	190	300	240	-	-	-	-
Ca	25	-	220	50	25	24	≤20	≤20	≤20	-
V	150	-	-	<150	<60	<60	<1000	<1000	<1000	<1000
Cr	2110	-	~1100	~700	~750	~600	1600	1600	1200	1400
Mn	50	-	65	35	38	36	<200	~200	<200	~200
Fe	6190	6240	4980	3610	2720	2380	4330	3360	3150	3100
Co	<12	-	<11	<12	<13	<12	<1000	<1000	<1000	<1000
Ni	~980	-	~1100	~700	380	240	≤200	≤200	≤200	2000
Cu	75	-	-	<50	-	-	-	-	-	-
Zn	25	-	43	47	<25	<24	-	-	-	-
As	-	-	<4000	-	<4000	-	-	<2000	<2000	<2000
Sr	<1	-	<1	<1	<1.2	<1.2	<20	~200	<200	≥20
Zr	-	-	-	-	-	-	<1000	<1000	<1000	<200
Ag	-	-	-	-	-	-	-	-	-	-
Cd	<25	-	<22	<24	<25	<24	<1000	<1000	<1000	<1000
In	<15	-	-	<15	<30	<30	-	-	-	-
Sn	1120	-	110	395	2015	95	≤1000	≤1000	≤1000	≤400
Sb	<100	-	-	<100	<60	<60	<2000	<2000	<2000	-
Ba	<1	-	<1	<1	<1.2	<1.2	<20	<20	<100	<1000
La	~2000	-	14000	~4200	4000	3000	8000	10000	8200	6000
Ce	<25	-	<22	<240	<25	<24	<2000	<1950	<2000	<2000
Hg	<50	-	<43	<50	<50	<48	<4000	<4000	<4000	<4000
Tl	<150	-	-	100	<100	<100	-	-	-	-
Pb	60	-	65	35	75	60	<200	~200	<200	<200
Bi	-	-	<1000	-	<1000	<1000	<1000	<1000	<1000	<1000
Th	-	-	-	-	-	-	<2000	-	<4000	<4000
U	~100	-	~100	~100	~100	~100	<2000	-	<4000	<4000
Pu^{VI}	34	-	-	-	-	45	-	-	-	-
Solids	333	78	181	128	600	374	-	-	-	-
a. Si	10	-	-	20	12	-	-	-	-	-
b. Sn	60	-	-	56	66	-	-	-	-	-
c. Cr	10	-	-	-	-	-	-	-	-	-
d. Fe	20	-	-	24	28	-	-	-	-	-

[redacted]

	81-H	82-H	83-H	84-H	85-H	86-H	87-H	88-H	89-H	90-H
Irradiation	210	213	204	203	200	193	194	191	198	206
Li	-	-	-	-	-	-	-	-	-	<1.8
Be	<10	<10	<10	<10	<10	<10	<10	<10	<10	<0.1
B	-	-	-	-	-	-	-	-	-	<1
Na	-	-	-	-	-	-	-	-	-	10
Mg	≤20	≤20	<20	≤20	≤20	≤20	≤20	<20	<20	5
Al	<20	<20	<20	<200	<20	<20	<200	<200	<200	8
Si	-	-	-	-	-	-	-	-	-	460
P	1275	1235	1147	1402	1464	1500	1226	1305	1150	1237
$SO_4^=$	-	-	-	-	-	-	-	-	-	25
K	-	-	-	-	-	-	-	-	-	250
Ca	≤20	≤20	<20	<20	≤20	<20	<20	<20	<20	25
V	<1000	<960	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<500
Cr	1300	1200	1200	1200	1600	1600	1200	1400	1400	1200
Mn	<200	≤200	<200	<200	<200	<200	<200	<200	<200	18
Fe	2710	3160	2560	3180	2870	3240	2910	4180	4320	3820
Co	<1000	<960	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<13
Ni	≤200	<200	≤200	2000	≤200	≤200	-	3000	3000	2000
Cu	-	-	-	-	-	-	-	-	-	30
Zn	-	-	-	-	-	-	-	-	-	50
As	<2000	<1900	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<2000
Sr	<200	<200	<200	≤20	<200	<200	≤20	≤20	≤20	<1
Zr	<1000	<960	<1000	<200	<1000	<1000	<200	<200	<200	<200
Ag	-	-	-	-	-	-	-	-	-	-
Cd	<1000	<960	<1000	<1000	<1000	1000	<1000	<1000	<1000	<13
In	-	-	-	-	-	-	-	-	-	<6
Sn	≤1000	≤960	<1000	≤400	≤1000	≤1000	≤400	≤400	≤400	610
Sb	<2000	<2000	<2000	-	<2000	<2000	-	-	-	<25
Ba	<20	<20	<20	<1000	<20	<20	<1000	<1000	<1000	<13
La	8000	8000	8000	10000	10000	10000	4000	4000	2000	2000
Ce	<2000	<1900	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<25
Hg	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<50
Tl	-	-	-	-	-	-	-	-	-	<6
Pb	<200	<200	<200	<200	<200	<200	<200	<200	<200	13
Bi	<1000	<960	<1000	<1000	<1000	<1000	<1000	<1000	<1000	250
Th	-	<3800	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000
U	-	<3800	<4000	<4000	<4000	<4000	<4000	<4000	<4000	100
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	242
a. Si	-	-	-	-	-	-	-	-	-	28
b. Sn	-	-	-	-	-	-	-	-	-	48
c. Fe	-	-	-	-	-	-	-	-	-	24

	91-H	92-H	93-H	94-H	95-H	96-H	97-H	98-H	99-H	100-H
Irradiation	189	204	185	182	186	186	181	181	-[d]	196
Li	-	-	<1.3	-	-	-	1.3	<1.3	-	<1.3
Be	<10	<10	/ <0.1	<10	<10	<10	<0.1	<0.1	<10	<0.1
B	-	-	<1	-	-	-	<1	<1	-	1.5
Na	-	-	125	-	-	-	175	330	-	210
Mg	20	<20	2.5	<20	<20	<20	5	8	<20	26
Al	<200	<100	5	<200	<200	<200	5	5	≤200	<3
Si	-	<100	490	-	-	-	230	450	-	980
P	1091	1345	1422	1094	1225	1295	1054	1133	-	1042
$SO_4^{=}$	-	-	16.8	-	-	-	18.2	22.5	-	14.3
K	-	-	200	-	-	-	200	200	-	50
Ca	<20	-	13	<100	<100	<100	13	50	<100	130
V	<1000	<1000	<300	<1000	<1000	<1000	<300	<300	<1000	<300
Cr	600	2000	1500	1200	1200	1200	700	2000	≤2000	770
Mn	<200	<1000	15	<1000	<1000	<1000	23	25	<1000	77
Fe	3500	3370	3420	2890	3760	4040	4955	6160	5050	3495
Co	<1000	<1000	<13	<1000	<1000	<1000	<13	<13	<1000	<13
Ni	800	<200	~1000	<1000	<1000	<1000	~1000	~1000	<1000	~650
Cu	-	-	20	-	-	-	30	50	-	40
Zn	-	-	<50	-	-	-	<50	<50	-	260
As	<2000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<10000	<10000
Sr	≤20	<100	<1	<100	<100	<100	<1	<1	<200	<1.3
Zr	<200	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000
Ag	-	-	-	-	-	-	-	-	-	-
Cd	<1000	<1000	<13	<1000	<1000	<1000	<13	<13	<1000	77
In	-	-	<6	-	-	-	<6	<6	-	<6
Sn	≤400	<2000	1000	<1000	<1000	<1000	180	185	<2000	940
Sb	-	-	<25	-	-	-	<25	<25	-	<25
Ba	<1000	<200	<13	<100	<100	<100	<13	<13	<1000	<3
La	1000	3000	~2500	1400	<3000	4000	2000	~2500	<2000	~770
Ce	<2000	<2000	<25	<2000	<200	<2000	<25	<25	<4000	<50
Hg	<4000	-	<50	-	-	-	<50	<50	-	<50
Tl	-	-	<6	-	-	-	<6	<6	-	<6
Pb	<200	<1000	13	<1000	<1000	<1000	25	25	<1000	<26
Bi	<1000	<1000	250	<2000	<2000	<2000	500	500	<1000	250
Th	<4000	<4000	-	<4000	<4000	<4000	<4000	<4000	<4000	-
U	<4000	-	100	-	-	-	100	100	-	100
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-	-	500	-	-	-	51.3	137	-	542
a. Si	-	-	25	-	-	-	56	81	-	62
b. Sn	-	-	38	-	-	-	30	9	-	26
c. P	-	-	28	-	-	-	-	7	-	9
d. Fe	-	-	9	-	-	-	14	3	-	3

[redacted]

[redacted]

[redacted]BLE II-A (Cont.)

	101-H	102-H	103-H	104-H	105-H	106-H	107-H	108-H	109-H	110-H
Irradiation	212	188	213	219	198	201	215	175	209	193
Li	-	-	-	-	-	-	-	-	-	<1.3
Be	<10	<10	<10	<10	<10	<10	<10	<10	<10	<0.1
B	-	-	-	-	-	-	-	-	-	<1
Na	-	-	-	-	-	-	-	-	-	150
Mg	≤20	≤20	≤20	≤20	≤20	≤20	≤20	<20	<20	15
Al	≤200	≤200	≤200	<200	≤200	≤200	≤200	<100	<100	<3
Si	-	-	-	-	-	-	-	-	-	1650
P	-	-	-	-	-	-	-	-	-	1345
$SO_4^{=}$	-	-	-	-	-	-	-	-	-	21.4
K	-	-	-	-	-	-	-	-	-	370
Ca	<100	<100	<100	<100	<100	<100	<100	<20	<20	100
V	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<300
Cr	≤2000	≤2000	<1000	1000	<1000	1000	1000	2000	2000	700
Mn	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	60
Fe	2650	2870	2580	3170	2970	3020	3460	3200	2630	3715
Co	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<12
Ni	<1000	<1000	<1000	<1000	<1000	<1000	<1000	≤1000	≤1000	500
Cu	-	-	-	-	-	-	-	-	-	30
Zn	-	-	-	-	-	-	-	-	-	2500
As	<10000	<10000	<10000	<10000	<10000	<10000	<10000	<4000	<4000	<4000
Sr	<200	<200	<200	<200	<200	<200	<200	<100	<100	<1.2
Zr	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	-
Ag	-	-	-	-	-	-	-	-	-	-
Cd	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<25
In	-	-	-	-	-	-	-	-	-	<6
Sn	<2000	<2000	<2000	<2000	<2000	<2000	6000	<1000	<1000	830
Sb	-	-	-	-	-	-	-	-	-	<25
Ba	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<200	<200	<3
La	<2000	<2000	<2000	<2000	<2000	<2000	<2000	≤2000	≤2000	6000
Ce	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<60
Hg	-	-	-	-	-	-	-	-	-	<60
Tl	-	-	-	-	-	-	-	-	-	<6
Pb	<1000	<1000	<1000	<1000	<1800	<1000	<1000	<1000	<1000	<25
Bi	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	250
Th	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	-
U	-	-	-	-	-	-	-	-	-	<60
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	741
a. Si	-	-	-	-	-	-	-	-	-	77
b. Sn	-	-	-	-	-	-	-	-	-	17
c. Fe	-	-	-	-	-	-	-	-	-	6

[redacted]

TABLE II-A (Cont.)

	111-H	112-H	113-H	114-H	115-H	116-H	117-H	118-H	119-H	120-H
Irradiation	203	191	200	204	208	191	210	210	219	219
Li	-	-	-	-	-	-	-	-	-	<1.3
Be	<10	<10	<10	<10	<10	<10	<10	<10	<10	<0.1
B	-	-	-	-	-	-	-	-	-	0.5
Na	-	-	-	-	-	-	-	-	-	260
Mg	<20	<20	<20	<20	<20	<20	<20	<20	<20	26
Al	<100	<100	<100	<100	<100	<100	<100	<100	<100	5
Si	-	-	-	-	-	-	-	-	-	490
P	-	-	-	-	-	-	-	-	-	1570
$SO_4^{=}$	-	-	-	-	-	-	-	-	-	2%.2
K	-	-	-	-	-	-	-	-	-	53
Ca	200	200	200	100	160	≤20	≤20	20	20	80
V	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<300
Cr	1000	1000	2000	1000	1600	1600	1000	1600	1600	400
Mn	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	80
Fe	2500	2750	3600	4030	3700	3230	3090	3520	3840	2569
Co	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<13
Ni	≤1000	≤1000	4000	2000	≤1000	≤1000	≤1000	1600	≤1000	320
Cu	-	-	-	-	-	-	-	-	-	30
Zn	-	-	-	-	-	-	-	-	-	≤53
As	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	-
Sr	<100	<100	<100	<100	<100	<100	<100	<100	<100	<1.3
Zr	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	-
Ag	-	-	-	-	-	-	-	-	-	-
Cd	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	26
In	-	-	-	-	-	-	-	-	-	<6
Sn	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	174
Sb	-	-	-	-	-	-	-	-	-	<25
Ba	<200	<200	<200	<200	<200	<200	<200	<200	<200	<3
La	<2000	<2000	4000	2000	4000	<2000	1000	<2000	<2000	~2100
Ce	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<26
Hg	-	-	-	-	-	-	-	-	-	130
Tl	-	-	-	-	-	-	-	-	-	<6
Pb	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<26
Bi	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	250
Th	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	-
U	-	-	-	-	-	-	-	-	-	≤50
Solids	-	-	-	-	-	-	-	-	-	137
a. Si	-	-	-	-	-	-	-	-	-	94
b. Sn	-	-	-	-	-	-	-	-	-	2
c. Fe	-	-	-	-	-	-	-	-	-	2
	-	-	-	-	-	-	-	-	-	2

	121-H	122-H	123-H	124-H	125-H	126-H	127-H	128-H	129-H	130-H
Irradiation	212	207	212	210	207	211	213	214	220	217
Li	-	-	-	-	-	-	-	-	-	<2.5
Be	<10	<10	<10	<10	<10	<10	<10	<10	<10	<0.1
B	-	-	-	-	-	-	-	-	-	<0.5
Na	-	-	-	-	-	-	-	-	-	160
Mg	40000	<20	<20	<20	<20	<20	<20	<20	<20	80
Al	<200	<200	<200	<200	<200	<200	<200	<200	<200	18
Si	-	-	-	-	-	-	-	-	-	750
P	-	-	-	-	-	-	-	-	-	1274
$SO_4^{=}$	-	-	-	-	-	-	-	-	-	17.6
K	-	-	-	-	-	-	-	-	-	250
Ca	-	-	-	-	-	-	-	-	-	130
V	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<600
Cr	2000	1600	2000	2000	2000	2000	2000	2000	2000	~650
Mn	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	130
Fe	4200	2910	4060	3450	3330	4860	3890	4840	4600	3890
Co	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<13
Ni	20000	<1000	<1000	<1000	<1000	<1000	-	<1000	<1000	~750
Cu	-	-	-	-	-	-	-	-	-	30
Zn	-	-	-	-	-	-	-	-	-	<70
As	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	-
Sr	<100	<100	<100	<100	<100	<100	<100	<200	<200	<3
Zr	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	-
Ag	-	-	-	-	-	-	-	-	-	<6
Cd	<2000	<2000	<2000	<2000	<2000	<2000	<2000	<1000	<1000	<25
In	-	-	-	-	-	-	-	-	-	-
Sn	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	330
Sb	-	-	-	-	-	-	-	-	-	<30
Ba	<200	<200	<200	<200	<200	<200	<200	<200	<200	<3
La	2000	2000	<2000	<2000	<2000	≤2000	<2000	10000	10000	2600
Ce	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<25
Hg	-	-	-	-	-	-	-	-	-	-
Tl	-	-	-	-	-	-	-	-	-	-
Pb	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	130
Bi	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	~150
Th	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	-
U	-	-	-	-	-	-	-	-	-	60
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	89
a. Si	-	-	-	-	-	-	-	-	-	81
b. Sn	-	-	-	-	-	-	-	-	-	9
c. Fe	-	-	-	-	-	-	-	-	-	4
d. Zn	-	-	-	-	-	-	-	-	-	6

[redacted]

	131-H	132-H	133-H	134-H	135-H	136-H	137-H	138-H	139-H	140-H
Irradiation	213	206	209	200	205	206	210	210	208	219
Li	-	-	-	-	-	-	-	-	-	<2.5
Be	<10	<10	<10	<10	<10	<10	<10	<10	<10	<1.3
B	-	-	-	-	-	-	-	-	-	2
Na	-	-	-	-	-	-	-	-	-	52
Mg	<20	<20	<20	<20	<20	<22	<20	<20	<20	26
Al	<200	<200	<200	<200	<200	<220	<200	<200	<200	16
Si	-	-	-	-	-	-	-	-	-	630
P	-	-	-	-	-	-	-	-	-	1350
$SO_4^{=}$	-	-	-	-	-	-	-	-	-	20.7
K	-	-	-	-	-	-	-	-	-	~780
Ca	<20	<20	<20	<20	<20	<22	<20	<20	<20	52
V	<1000	<1000	<1000	<1000	<1000	<1100	<1000	<1000	<1000	<600
Cr	3000	4000	1000	1000	<1000	1100	1000	1000	1000	~650
Mn	<1000	<1000	<1000	<1000	<1000	-	<1000	<1000	<1000	106
Fe	4850	3580	5170	4350	3310	3210	4580	4710	4460	4965
Co	<1000	<1000	<1000	<1000	<1000	<1100	<1000	<1000	<1000	<13
Ni	1000	1000	<1000	<1000	<1000	1100	1000	1000	<1000	~800
Cu	-	-	-	-	-	-	-	-	-	25
Zn	-	-	-	-	-	-	-	-	-	<75
As	<4000	<4000	<4000	<4200	<4000	<4400	<4000	<4000	<4000	-
Sr	<100	<100	<100	<100	<100	<100	<100	<100	<100	<3
Zr	<1000	<1000	<1000	<1000	<1000	<1100	<1000	<1000	<1000	-
Ag	-	-	-	-	-	-	-	-	-	<6
Cd	<1000	<1000	<1000	<1000	<1000	<1100	<1000	<1000	<1000	<26
In	-	-	-	-	-	-	-	-	-	-
Sn	<1000	<1000	<1000	<1000	<1000	<1100	<1000	<1000	<1000	310
Sb	-	-	-	-	-	-	-	-	-	<30
Ba	<1000	<1000	<1000	<1000	<1000	<1100	<1000	<1000	<1000	<3
La	40000	40000	40000	20000	<2000	22000	40000	40000	20000	~2600
Ce	<4000	<4000	<4000	<4200	<4000	<4400	<4000	<4000	<4000	<26
Hg	-	-	-	-	-	-	-	-	-	-
Tl	-	-	-	-	-	-	-	-	-	-
Pb	<1000	<1000	<1000	<1000	<1000	<1100	<1000	<1000	<1000	130
Bi	<1000	<1000	<1000	<1000	<1000	<1100	<1000	<1000	<1000	~350
Th	<4000	<4000	<4000	<4000	<4000	<4400	<4000	<4000	<4000	-
U	-	-	-	-	-	-	-	-	-	~80
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	154
a. Si	-	-	-	-	-	-	-	-	-	92
b. Fe	-	-	-	-	-	-	-	-	-	5
c. Zn	-	-	-	-	-	-	-	-	-	3

[redacted]

APPROVED FOR PUBLIC RELEASE

[redacted] TABLE II-A (Cont.)

	141-H	142-H	143-H	144-H	145-H	146-H	147-H	148-H	149-H	150-H
Irradiation	220	216	221	222	222	217	217	215	218	218
Li	-	-	-	-	-	-	-	-	-	<0.2
Be	<10	<10	<10	<10	<10	<10	<10	<10	<10	<0.1
B	-	-	-	-	-	-	-	-	-	1.8
Na	-	-	-	-	-	-	-	-	-	60
Mg	<20	<20	<20	<20	<20	<20	<100	<100	<100	10
Al	<200	<200	<200	<200	<200	<200	<200	<200	<200	20
Si	-	-	-	-	-	-	-	-	-	470
P	-	-	-	-	-	-	-	-	-	1365
$SO_4^{=}$	-	-	-	-	-	-	-	-	-	18.9
K	-	-	-	-	-	-	-	-	-	400
Ca	<20	<20	<20	<20	<20	<20	<100	<100	<100	~300
V	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	600
Cr	<1000	1000	1000	1000	1000	<1000	4000	4000	4000	~1200
Mn	<1000	<1000	<1000	<1000	<1000	<1000	≤1000	≤1000	≤1000	60
Fe	4550	3660	3090	3350	8440	3910	3960	3610	2800	3015
Co	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<10
Ni	<1000	<1000	<1000	<1000	<1000	<1000	≤1000	≤1000	≤1000	~800
Cu	-	-	-	-	-	-	-	-	-	20
Zn	-	-	-	-	-	-	-	-	-	-
As	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	-
Sr	<100	<100	<100	<100	<100	<100	<100	<100	<100	<1
Zr	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	-
Ag	-	-	-	-	-	-	-	-	-	<6
Cd	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<20
In	-	-	-	-	-	-	-	-	-	-
Sn	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	~420
Sb	-	-	-	-	-	-	-	-	-	<30
Ba	<1000	<1000	<1000	<1000	<1000	<1000	<100	<100	<100	~2
La	40000	40000	40000	40000	20000	40000	<10000	<10000	<10000	~4000
Ce	<4000	<4000	<4000	<4000	<4000	<4000	-	-	-	<40
Mg	-	-	-	-	-	-	-	-	-	<20
Tl	-	-	-	-	-	-	-	-	-	-
Pb	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	80
Bi	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	~350
Th	<4000	<4000	<4000	<4000	<4000	<4000	<1000	<4000	<4000	-
U	-	-	-	-	-	-	-	-	-	75
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	122
a. Si	-	-	-	-	-	-	-	-	-	50
b. Sn	-	-	-	-	-	-	-	-	-	19
c. Fe	-	-	-	-	-	-	-	-	-	6
d. Zn	-	-	-	-	-	-	-	-	-	25

[redacted]

[redacted] TABLE II-A (Cont.)

	151-H	152-H	153-H	154-H	155-H	156-H	157-H	158-H	159-H	160-H
Irradiation	216	219	219	217	222	222	216	222	233	241
Li	-	-	-	-	-	-	-	-	-	<0.2
Be	<10	<10	<10	<10	<10	<10	<10	<10	<10	<0.1
B	-	-	-	-	-	-	-	-	-	1
Na	-	-	-	-	-	-	-	-	-	60
Mg	1000	<100	<100	<100	<100	<100	<100	<100	<100	6
Al	1000	<200	<200	<200	<200	<200	<200	<200	<200	2
Si	-	-	-	-	-	-	-	-	-	760
P	-	-	-	-	-	-	-	-	-	1412
$SO_4^{=}$	-	-	-	-	-	-	-	-	-	15.6
K	-	-	-	-	-	-	-	-	-	60
Ca	1000	<100	<100	<100	<100	<100	<100	<100	<100	60
V	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<600
Cr	2000	4000	2000	4000	4000	4000	4000	4000	4000	~1000
Mn	≤1000	≤1000	≤1000	≤1000	≤1000	≤1000	≤1000	≤1000	≤1000	42
Fe	3670	2880	2910	3950	3290	3400	3270	2880	3500	3295
Co	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<10
Ni	4000	2000	≤1000	≤1000	2000	≤1000	≤1000	≤1000	4000	~800
Cu	-	-	-	-	-	-	-	-	-	40
Zn	-	-	-	-	-	-	-	-	-	20
As	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	-
Sr	<100	<100	<100	<100	<100	<100	<100	<100	<100	<1
Zr	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	-
Ag	-	-	-	-	-	-	-	-	-	10
Cd	<1000	<100	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<21
In	-	-	-	-	-	-	-	-	-	-
Sn	<1000	2000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	186
Sb	-	-	-	-	-	-	-	-	-	<30
Ba	<100	<100	<100	<100	<100	<100	<100	<100	<100	<2
La	<10000	10000	<10000	<10000	<10000	<10000	<10000	<10000	<10000	~1000
Ce	-	-	-	-	-	-	-	-	-	<42
Hg	-	-	-	-	-	-	-	-	-	≤21
Tl	-	-	-	-	-	-	-	-	-	-
Pb	20000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	21
Bi	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	<1000	~350
Th	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	<4000	-
U	-	-	-	-	-	-	-	-	-	[redacted]
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	70
a. Si	-	-	[redacted]				-	-	-	67
b. Sn	-	-					-	-	-	5
c. Fe	-	-					-	-	-	2
d. Zn	-	-					-	-	-	6

[redacted] • 12-A (Cont.)

	161-H	162-H	163-H	164-H	165-H	166-H	167-H	168-H	169-H	170-H[a]
Irradiation	244	224	244	231	223	220	236	223	231	233
Li	-	-	-	-	-	-	-	-	-	<0.2
Be	<10	<10	<10	<10	<10	<10	<10	<10	<10	<0.1
B	-	-	-	-	-	-	-	-	-	11
Na	-	-	-	-	-	-	-	-	-	~300
Mg	<100	<100	<100	<100	<100	<100	<100	<100	<100	20
Al	<200	<200	<200	<210	<210	<210	<210	<200	<200	30
Si	-	-	-	-	-	-	-	-	-	200
P	-	-	-	-	-	-	-	-	-	1476
$SO_4^{=}$	-	-	-	-	-	-	-	-	-	18.5
K	-	-	-	-	-	-	-	-	-	500
Ca	<100	<100	<100	<100	<100	<100	<100	<100	<100	80
V	<1000	<1000	<1000	<1050	<1050	<1050	<1070	<1000	<1000	<600
Cr	4000	2000	2000	1050	1050	1050	≤1070	≤1000	≤1000	~1000
Mn	≤1000	≤1000	≤1000	<1050	<1050	<1050	-	<1000	<1000	180
Fe	2920	3080	2770	3180	3590	4200	3080	3990	5480	8690
Co	<1000	<1000	<1000	<1050	<1050	<1050	<1070	<1000	<1000	<10
Ni	20000	≤1000	≤1000	<1050	<1050	<1050	<1070	<1000	<1000	~1000
Cu	-	-	-	-	-	-	-	-	-	40
Zn	-	-	-	-	-	-	-	-	-	40
As	<4000	<4000	<4000	<4000	<4200	<4200	<4300	<4000	<4000	-
Sr	<100	<100	<100	<100	<100	<100	<100	<100	<100	<1
Zr	<1000	<1000	<1000	<1050	<1050	<1050	<1070	<1000	<1000	-
Ag	-	-	-	-	-	-	-	-	-	<6
Cd	<1000	<1000	<1000	<1050	<1050	<1050	<1070	<1000	<1000	<20
In	-	-	-	-	-	-	-	-	-	-
Sn	<1000	<1000	<1000	<1050	<1050	<1050	<1070	-	<1000	~300
Sb	-	-	-	-	-	-	-	-	-	<30
Ba	<100	<100	<100	<100	<100	<100	<100	<100	<100	3
La	<10000	<10000	<10000	<10500	<10500	<10500	<10700	<10000	<10000	~4000
Ce	-	-	-	<8400	<8400	<8400	<8600	<8000	<8000	60
Hg	-	-	-	-	-	-	-	-	-	≤20
Tl	-	-	-	-	-	-	-	-	-	-
Pb	<1000	<1000	<1000	<1050	<1050	<1050	<1070	<1000	<1000	100
Bi	<1000	<1000	<1000	<1050	<1050	<1050	<1070	<1000	<1000	~700
Th	<4000	<4000	<4000	<4200	<4200	<4200	<4300	<4000	<4000	-
U	-	-	-	-	-	-	-	-	-	-[c]
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	25.6
a. Si	-	-	-	-	-	-	-	-	-	-[c]
b. Sn	-	-	-	-	-	-	-	-	-	-[c]

This document contains information affecting the nat[redacted]
[redacted]
[redacted] by law.

	171-H	172-H	173-H	174-H	175-H	176-H	177-H	178-H	179-H	180-H[a]
Irradiation	242	231	228	224	228	234	240	251	251	-[d]
Li	-	-	-	-	-	-	-	-	-	0.4
Be	<10	<10	<10	<10	<10	<10	<10	<10	<10	<0.1
B	-	-	-	-	-	-	-	-	-	3
Na	-	-	-	-	-	-	-	-	-	145
Mg	<100	<100	<100	<100	<100	<100	<100	<100	<100	13
Al	<200	<210	<200	<200	<200	<200	<210	<200	<210	8
Si	-	-	-	-	-	-	-	-	-	250
P	-	-	-	-	-	-	-	-	-	1935
$SO_4^{=}$	-	-	-	-	-	-	-	-	-	37
K	-	-	-	-	-	-	-	-	-	~630
Ca	<100	<100	<100	<100	<100	<100	<100	<100	<100	84
V	<1000	<1070	<1000	<1000	<1000	<1000	<1070	<1000	<1070	<600
Cr	≤1000	≤1070	≤1000	-	≤1000	≤1000	≤1070	≤1000	≤1070	~1060
Mn	<1000	<1070	<1000	<1000	<1000	<1000	<1070	<1000	<1070	105
Fe	4250	3650	3620	3440	6270	5990	4280	3160	3700	7990
Co	<1000	<1070	<1000	<1000	<1000	<1000	<1070	<1000	<1070	<11
Ni	<1000	<1070	<1000	<1000	<1000	<1000	<1070	<1000	<1070	~2100
Cu	-	-	-	-	-	-	-	-	-	60
Zn	-	-	-	-	-	-	-	-	-	<42
As	<4000	<4300	<4000	<4000	<4000	<4000	<4300	<4000	<4300	-
Sr	<100	<100	<100	<100	<100	<100	<100	<100	<100	<1
Zr	<1000	<1070	<1000	<1000	<1000	<1000	<1070	<1000	<1070	-
Ag	-	-	-	-	-	-	-	-	-	10
Cd	<1000	<1070	<1000	<1000	<1000	<1000	<1070	<1000	<1070	11
Sn	<1000	<1070	<1000	<1000	<1000	<1000	<1070	<1000	<1070	630
Sb	-	-	-	-	-	-	-	-	-	<30
Ba	<100	<100	<100	<100	<100	<100	<100	<100	<100	4
La	<10000	<10700	<10000	10000	<10000	<10000	<10700	<10000	<10700	~4200
Ce	<8000	<8600	<8000	<8000	<8000	<8000	<8600	<8000	<8600	42
Hg	-	-	-	-	-	-	-	-	-	-
Tl	-	-	-	-	-	-	-	-	-	-
Pb	<1000	<1070	<1000	<1000	<1000	<1000	<1070	<1000	<1070	210
Bi	<1000	<1070	<1000	<1000	<1000	<1000	<1070	<1000	<1070	~350
Th	<4000	<4300	<4000	<4000	<4000	<4000	<4300	<4000	<4300	-
U	-	-	-	-	-	-	-	-	-	-[c]
Pu^{VI}	-	-	-	-	-	-	-	-	-	-
Solids	-	-	-	-	-	-	-	-	-	107.8
a. Si	-	-	-	-	-	-	-	-	-	-[c]
b. Sn	-	-	-	-	-	-	-	-	-	-[c]

[redacted]

[redacted]

[redacted] TABLE II-A (Cont.)

	181-H	182-H	183-H	184-H	185-H
Irradiation	256	258	260	262	269
Li	-	-	-	-	-
Be	<10	<10	<10	<10	<10
B	-	-	-	-	-
Na	-	-	-	-	-
Mg	<100	<100	<100	<100	<100
Al	<200	<200	<200	<200	<210
Si	-	-	-	-	-
P	-	-	-	-	-
$SO_4^{=}$	-	-	-	-	-
K	-	-	-	-	-
Ca	<100	<100	<100	<100	<100
V	<1000	<1000	<1000	<1000	<1070
Cr	≤1000	≤1000	≤1000	≤1000	≤1070
Mn	<1000	<1000	<1000	<1000	<1070
Fe	3190	3250	4180	3880	3430
Co	<1000	<1000	<1000	<1000	<1070
Ni	<1000	<1000	<1000	<1000	<1070
Cu	-	-	-	-	-
Zn	-	-	-	-	-
As	<4000	<4000	<4000	<4000	<4300
Sr	<100	100	<100	<100	<100
Zr	<1000	<1000	<1000	<1000	<1070
Ag	-	-	-	-	-
Cd	<1000	<1000	<1000	<1000	<1070
In	-	-	-	-	-
Sn	<1000	<1000	<1000	<1000	<1070
Sb	-	-	-	-	-
Ba	<100	<100	<100	<100	<100
La	<10000	<10000	<10000	<10000	<10700
Ce	<8000	<8000	<8000	<8000	<8600
Hg	-	-	-	-	-
Tl	-	-	-	-	-
Pb	<1000	<1000	<1000	<1000	<1070
Bi	<1000	<1000	<1000	<1000	<1070
Th	<4000	<4000	<4000	<4000	<4300
U	-	-	-	-	-
Pu^{VI}	-	-	-	-	-
Solids	-	-	-	-	-
a. Si	-	-	-	-	-
b. Sn	-	-	-	-	-

TABLE II-A

Notes

on the Data

a Although the total weight of the solids in this lot was determined, the residue was not analyzed. Since the sample for the cupferron or direct spark analysis which was performed on this lot was taken from the supernatant above the centrifuged solids, the values reported for some elements, especially Si, Fe, and Sn, are probably low.

b Unless otherwise indicated, a dash indicates that the datum was not requested.

c Analysis was requested, but not reported.

d This lot was a composite of recycles; hence no irradiation data are available.

TABLE II-B

Summary of Purity of Incoming Material

Notes

on the Headings

All elements except S as $SO_4^{=}$ have been reported as parts per million parts of plutonium. S has been reported as weight per cent of $SO_4^{=}$ to Pu. (For example, 16 grams of $SO_4^{=}$, as determined volumetrically, in an "H" lot of 160 grams of Pu, would be reported as 10% $SO_4^{=}$.

Solids have been reported as the total weight, in milligrams of centrifugable solid matter, dried to constant weight at 110°-120°C.

a The "average" figure which is reported is that value below which 90% or more of the determinations fell.

b The number is the total number of determinations used to compute the "average" value.

[redacted]

TABLE III

Purity Record of Purified Plutonium

Table III is a summary of the impurities present after purification. By comparison with Tables I and II of this report, the following information can be found for many purification lots.

(1) Principal impurities present in the incoming plutonium (Table II)

(2) Purification methods used to obtain pure Pu (Table I)

(3) Actual purity of the final product (Table III).

Impurities are listed as parts by weight per million parts by weight of plutonium (ppm)

Notations used in Table III as superscripts.

- No working by the ppm. of any impurity indicates analysis was made after a diethyl ether extraction of Pu (VI) nitrate.

a- Indicates analysis made after a Pu (III) oxalate precipitation.

b- Indicates analysis made after a Pu (VI) acetate precipitation.

c- Indicates analysis made after the purified plutonium has been reduced to the metal by Baker's group.

d- Indicates analysis made after dry conversion of the purified plutonium to the tetraflouride by Garner's group.

e- Indicates analysis made after the reduced metal has been remelted by Hammel's group.

[redacted]

	1-W to 118-K		118-K to 184-K		1-W to 184-K	
	Average[a]	Number[b]	Average[a]	Number[b]	Average[a]	Number[b]
Li	<4	22	<0.4	7	<3	29
Be	<0.7	22	<1.3	7	<0.4	29
B	1.8	11	11	7	2	18
Na	380	22	300	7	320	29
Mg	200	118	100	65	200	183
Al	21	25	1000	7	100	32
SiX	2700	17	760	5	1600	22
P	1494	39	1570	7	1470	46
$SO_4^{=}$	25	19	37	7	24	26
K	980	21	780	7	900	28
Ca	340	112	160	56	200	168
V	<600	14	<600	7	<600	21
Cr	5000	118	4500	64	5000	182
Mn	210	22	160	7	200	29
Fe	10300	117	4900	66	9400	182
Co	<17	22	<13	7	<15	29
Ni	360	116	2100	64	3000	180
Cu	125	13	60	7	80	19
Zn	260	21	<75	5	200	26
As	<10000	105	<4300	58	<4000	163
Sr	<3	22	<3	7	4	29
Zr	<1000	106	<1070	58	<1000	164
Ag	-	0	11	6	10	6
Cd	2000	22	26	7	1600	29
In	<30	14	<6	1	<30	15
Sn	2100	20	420	6	2000	26
Sb	<100	14	<30	7	<100	21
Ba	<13	22	4	7	<13	29
La	18000	118	41000	65	32000	183
Ce	<60	22	60	7	<50	29
Hg	<30	18	130	4	<50	19
Tl	<150	14	<6	1	<150	15
Pb	500	22	210	7	130	29
Bi	960	10	700	7	800	17
Th	<10000	100	<4300	58	<4000	158
U	140	20	80	4	100	24
Solids	740	17	184	6	740	23

[redacted]

[redacted]ABLE III. PURITY RECORD OF PURIFIED PRODUCT

Site Y Lot No.	7	9	12	14	16	18	20	22	24	26
Li	-	-	-	<0.4	<0.4	<0.5	<0.5	<1	-	<1
Be	-	<20	<40	0.5	<0.4	<0.5	<0.5	<1	<20	<1
Na	-	-	-	20	100	90	120	40	-	50
Mg	20	<200	<2000	100	10	<5	20	1	<200	<5
Al	<2000	<2000	<400	<5	<4	<2	<4	<5	<200	<5
K	-	-	-	-	-	-	-	-	-	20
Ca	<200	<200	<400	200	80	1	200	5	<200	<10
Cr	-	-	<2000	<200	<400	<200	-	-	<200	<200
Mn	-	-	-	-	-	-	-	-	-	-
Fe	<200	<200	<200	<200	<200	<200	-	-	<200	<200
Co	-	-	-	-	-	-	-	-	-	-
Ni	-	-	-	-	-	-	-	-	-	-
Zn	-	-	-	-	-	-	-	-	-	-
Sr	-	-	-	-	-	-	-	-	-	-
Zr	<2000	<2000	<400	<1000	<2000	<2000	-	-	200	<1000
Cd	-	-	-	-	-	-	-	-	-	-
Sn	-	-	-	-	-	-	-	-	-	-
Ba	-	-	-	-	-	-	-	-	-	-
La	<2000	<2000	<2000	<1000	1400	<100	-	-	400	<200
Ce	<10000	<10000	<4000	<4000	<2000	<4000	-	-	<4000	<4000
Hg	-	-	-	-	-	-	-	-	-	-
Pb	-	-	-	-	-	-	-	-	-	-
Th	2000	<10000	<4000	-	<1000	<400	-	-	<4000	<2000
U	-	-	-	-	-	-	-	-	-	-

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TABLE III (Cont.)

Site Y Lot No.	28	30	32	34	39	41	47	48	49-P	51-P
Li	<1	<1	<1	<1 <1*	<1	<1	<1	<1	<1	<1
Be	<1	<1	<1	<1 <5*	<1	<1	<1	<1	<0.5	<0.5
Na	28	30	65	10 <5*	15	<5	20	35	-	80
Mg	<5	<5	6	3 <7*	<1	<3	3	<2	10	5
Al	3	3	2	2 15*	10	<3	2	<1	<1	8
K	<15	6	<10	<10 <20*	<10	<20	<10	<20	35	10
Ca	25	55	16	<5 15*	25	5	5	<5	10	20
Cr	<200	<400	<200	<200	<200	<200	<200	<200	<200	<200
Fe	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Co	-	-	-	-	-	-	-	-	-	-
Ni	-	-	-	-	-	-	-	-	-	-
Zn	-	-	-	-	-	-	-	-	-	-
Sr	-	-	-	-	-	-	-	-	-	-
Zr	<1000	<400	<1000	<1000	<1000	-	-	<2000	-	<200
Cd	-	-	-	-	-	-	-	-	-	-
Sn	-	-	-	-	-	-	-	-	-	-
Ba	-	-	-	-	-	-	-	-	-	-
La	<1000	<2000	<1000	<1000	<400	<400	<400	<200	<400	<400
Ce	<1000	<2000	<2000	<2000	<1000	<200	<2000	<2000	<2000	<2000
Hg	-	-	-	-	-	-	-	-	-	-
Pb	-	-	-	-	-	-	-	-	-	-
Bi	<400	<200	<200	<200	<1000	<200	<200	<1000	<400	<200
Th	<2000	<1000	<1000	<1000	<1000	-	-	<2000	-	<200
U	800	400	>12000	150	150	500	>15000	200	200	200

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[redacted] TABLE III (cont.)

Site T Lot No.	52-P	54-P	56-P	58-P	60-P	62-P	64-P	66-P	68-P	70-P
Li	<1[a]	<1 ND[a]	<1 <1[a]	<1 <1[a] <1[c]	<1 <1[a] <1[c]	<1	<1	<1	<1	<1
Be	<0.5[a]	<0.5 ND[a]	<0.5 <0.5[a]	<5	<0.5 <0.5[a]	<0.5	<0.5	<0.5	<0.5	<0.5
Na	30[a]	660 ND[a]	120 20[c]	5	<5 <5[a,c]	50	60	[illegible]5	>1000	70
Mg	5[a]	10 20[a]	3 100[a]	[illegible]	[illegible] [illegible]-80[c] [illegible][a]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Al	50[a]	<1 ND[a]	<[illegible] <5[a]	[illegible]	<3 <3[a,c]	5	[illegible]	[illegible]	<20	3
K	<20[a]	20 ND[a]	60 <20[a]	<30	<30 <20[a,c]	<30	<20	<40	<40	<40
Ca	30[a]	15 30[a]	30 80[a]	5	<5 70-600[c] <10[a]	5	<5	70	40	30
Cr	-	<200	-	<200	<200	<200	-	-	-	<100
Mn	-	-	-	-	-	-	-	-	-	-
Fe	-	<400	<400	<400	<400	<400	-	-	-	<400
Co	-	-	-	-	-	-	-	-	-	-
Ni	-	-	-	-	-	-	-	-	-	-
Zn	-	-	-	-	-	-	-	-	-	-
Sr	-	-	-	-	-	-	-	-	-	-
Zr	-	<400	<200	-	<1000	<1000	-	-	-	<200
Cd	-	-	-	-	-	-	-	-	-	-
Sn	-	-	-	-	-	-	-	-	-	-
Ba	-	-	-	-	-	-	-	-	-	-
La	-	<400	<400	<400	<400	<400	-	-	-	<200
Ce	-	<2000	<1000	<1000	<2000	<2000	-	-	-	<1000
Hg	-	-	-	-	-	-	-	-	-	-
Pb	-	-	-	-	-	-	-	-	-	-
Bi	-	<200	<400	<400	<1000	<1000	<1000	-	-	<1000
Th	-	<2000	<2000	<2000	-	<4000	-	-	-	<2000
U	-	200	400	1000	670	840	1040	-	810	540

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[redacted] TABLE III (Cont.)

Site Y Lot No.	72-F	74-F	76-F	80-F	87-F	88-F 90-F	88 thru 98-F	104-F 106-F	201-F	[illegible]
Li	<1	<1	<1	<1	<1	-	-	-	-	-
Be	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<40[e]	<20[e,c]	0.5[e]	<20[a] <5[b] <4
Na	-	-	-	-	-	-	-	-	-	-
Mg	<3	20	<3	<3	<3	20	<400[e]	<20[e,c]	4-45[e]	<20[a] <40[b] <5
Al	<7	<3	<3	15	15	<400	<400[e]	<40[e,c]	40-1200[e]	200[a] <400[b] <20
K	-	-	-	-	-	-	-	-	<400[e]	-
Ca	5	70	<10	15	100	20	-	40[e] 100[c]	<4-9[e]	1000[a] 100[b] <20
Cr	<400	<400	<400	<200	<200	<200	<200[e]	<400[e] <40[c]	<6-8[e]	<1000[a] <500[b] <40
Mn	-	-	-	-	-	-	-	490[c] 250[e]	<6[e]	400[a] <200[b] <40
Fe	<400	<400	<400	<400	<400	<400	150[e]	-	175[e]	90[a] 250[b] 145
Co	-	-	-	-	-	-	-	-	-	<200[b] <40
Ni	-	-	-	-	-	-	<400[e]	-	-	<200[b] <40
Zn	-	-	-	-	-	-	-	-	<30[e]	<200[b] <40
Sr	-	-	-	-	-	-	-	-	-	<200[a] <20[b] <4
Zr	<200	<200	<200	<400	<400	<400	<400[e]	<400[e,c]	-	-
Cd	-	-	-	-	-	-	-	-	<70[e]	<2000[a] <200[b] <40
Sn	-	-	-	-	-	-	-	-	-	<200[b] <40
Ba	-	-	-	-	-	-	-	-	-	<2000[a] <200[b] <40
La	<200	<200	<200	<400	<400	<400	<1000[e]	<1000[e,c]	<60[e]	200,000[a] 160[b] <40
Ce	<1000	<1000	<1000	<1000	<1000	<1000	<1000[e]	<1000[e,c]	<30[e]	20,000[a] <5000[b] <400
U	-	510	164	<118	<700	-	-	-	-	-

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TABLE III (cont'd)

Site Y Lot No.	207-P	208-P	209-P	214 thru 216-P	220-P	222-P	223-P	227-P	228-P	229-P
Li	-	-	-	<4[cc]	-	<3	<3	<4	<4	-
Be	<0.4 <0.4[e]	<0.4	<0.3 <0.3[d]	<0.3[c] <0.5[e]	<0.4	<0.3	<0.3	<0.4	1.7	<0.3
Na	-	-	-	20[c] 7-13[e]	-	38	94	<4	83	-
Mg	40 70[e]	<4	10 <3[d]	17-80[e]	<4	6 <3	3	4	4	28
O	-	-	-	<100[e]	-	-	-	-	-	-
Al	40 70[e]	<4	7	50[c] 4-87[e]	15	10 3	6	13	13	16
K	-	-	-	<400[cc]	-	<310	<310	-	-	-
Ca	<20 35[e]	<<4	30 <3[d]	<7[c] <4-50[e]	35	31 6	13	42	33	16
Cr	100 <4[e]	<4	3 <3[d]	<4[c] <4[e]	<4	<3	<13	<4	<4	3
Mn	<40 7[e]	<4	<3 <3[d]	2-10[c] 2[e]	<4	1.6	<3	<4	<4	<3
Fe	42 15[e]	135	60 215[d]	80-200[e]	45	61 22	23	143	68	55
Co	43 15[e]	<40	<15 <15[d]	<17[c] <22[e]	<19	<16 <16	<16	<21	<21	<16
Ni	<40 <35[e]	<40	<15 <15[d]	<17[c] 17-60[e]	<19	<3 <3	<3	<8	<8	<16
Zn	<400 <35[e]	<40	<30 <30[d]	<17[c] <22[e]	<19	<31	63	<42	<42	9
Sr	<4[cc]	<4	<3	<300	<<4	<<3	<3	<4	<4	<3
Zr	-	-	-	-	-	<1000	<1000	<1000	<1000	-
Cd	<40 <20[e]	80	<15 <30[d]	<4[c] <30[e]	<19	<16	<16	<8	<8	9
Sn	<400 4[e]	<4	<15 <15[d]	<3[c] <9[e]	<4	<3	<3	<21	83	<3
Ba	<40 <35[e]	<40	<3 <3[d]	<3[c] <5[e]	<4	3	10	<4	6	3
La	<40 <4[e]	<4	<3 <15[d]	<17[c] <13[e]	<19	<16	<16	<4	<4	5
Ce	<400 <45[e]	<40	<30 <30[d]	<33[c] <25[e]	<38	<31	<31	<21	<21	<31
As	-	<40	<15[d]	-	-	<310	<310	-	-	-
Hg	-	120	<300[d] <400	<33[c] <220[e]	<38	<31	<31	<42	<42	<31
Pb	<40 100[e]	<40	30 <30[d]	<7[c] <17[e]	<4	<3	<3	8	210	47
Th	-	-	<30[d]	-	-	<2000	<2000	<2000	<2000	<2000
U	>>4000? <350[e]	<400	<400	-	<380	260	160	630	1500	-

[redacted]

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[redacted]

[redacted]

[redacted]

[redacted] TABLE III (Cont.)

Site Y Lot No.	227thru 229-P	230-P	231-P	232-P	239-P	242-P	243-P	244-P	245-P	246-P
Li	<4[e]	-	<5[a]	<5 <4[a] <0.8[e]	<5	-	<5 <4[e]	-	<4	<5
Be	<0.5[e]	<0.3	<0.4	<0.4[e]	<0.5	-	<0.4[e]	-	<0.4	<0.25
C	<100[e]	-	-	<200[e]	-	-	675[e]	<100[e]	-	-
Na	<96[e]	-	-	90 8[e]	110	-	35 <10[e]	-	32	50
Mg	5[e]	7	28	<4[e]	5	-	10[e]	4-240[e]	4	<5
O	<100[e]	-	-	<100[e]	-	-	<100[e]	<120[e]	-	-
Al	4-32[e]	17	7 5[a]	9 4[a] 19[e]	9	-	<4[e]	30[e]	16	<5
K	-	-	-	-	<440	-	<36[e]	8-31[e]	<400	1500
Ca	<5-30[e]	20	70 75[a]	23 10[a] 4[e]	20	-	11 420[e]	-	40	10
Cr	<5[e]	3	<4 <5[a]	<4[a] 11[e]	<5	125 <5	<4[e]	-	<4	5
Mn	<36[e]	<7	<4 <5[a]	<5 <4[a,e]	<5	-	36[e]	100[e]	<4	<5
Fe	7-70[e]	-	-	60 110[e]	-	-	-	-	40	22
Co	<33[e]	<17	<28 <25[a]	<23 <20[a,e]	<22	-	<18[e]	-	<20	<25
Ni	<72[e]	<17	<7 <10[a]	<3 <8[a]	<22	-	<18	-	<20	<25
Zn	<18[e]	10	-	<13	<15	-	>3000[e]	-	<10	-
Sr	<36[e]	<3	<7	<4[e]	<5	-	<4[e]	-	<4	<5
Zr	-	-	-	<200[e]	-	-	-	-	-	-
Cd	<27[e]	10	<18	45 20[a] <13[e]	<13	<27	-	-	<20	<25
Sn	<27[e]	<3	<18 5[a]	<19[e]	<22	-	<15[e]	-	<20	<25
Ba	<36[e]	-	11	5 <4[a,e]	<5	-	<4[e]	-	4	<5
La	<5[e]	3	<4	<4[e]	<5	-	<4[e]	-	<4	<0.05
Ce	-	<33	<25	<130[e]	<45	-	<36[e]	-	<40	<50
Hg	-	130	-	-	-	<46	-	<38[e]	<40	-
Pb	<36[e]	50	<4	45	<50	<100	<100[e]	<51[e]	<100	50
Bi	<1000[e]	-	-	<1[e]	-	-	-	-	-	-
Tl	-	3-30	-	10,000 150[a]	-	<460	-	-	-	-
U	-	-	-	10,000 150[a]	-	<460	-	-	<400	-

[redacted]

[redacted]

[redacted] TABLE III (Cont.)

Site Y Lot No.	255-P	256-P	257-P	268-P	269-P	270-P	270-P	270-P	271-P	272-P
Li	-	-	-	<2[e]	<2[e]	<2	<1[e]	<1[e]	<1[e]	<1[e]
Be	-	-	<10	<0.1[e]	<0.1[e]	<0.1	<0.1[e]	<0.1[e]	<0.1[e]	<0.1[e]
C	-	-	-	-	-	-	145[e]	[illegible][e]	205[e]	108[e]
O	-	-	-	-	<100[e]	-	<100[e]	<100[e]	<100[e]	<100[e]
Na	-	-	-	16[e]	60[e]	100	2[e]	10[e]	8[e]	12[e]
Mg	-	-	<200[e]	2[e]	2[e]	<0.2	2[e]	2[e]	3[e]	2[e]
Al	-	-	<200[e]	50[e]	29[e]	2[e]	41[e]	49[e]	76[e]	45[e]
K	-	-	-	<100[e]	<100[e]	<20[e]	<41[e]	<30[e]	<38[e]	<30[e]
Ca	500	1250	<200	18[e]	8[e]	16	<2[e]	8[e]	6[e]	8[e]
Cr	-	-	<200	-	-	<2	-	-	-	-
Mn	-	-	<400	-	-	<2	-	-	-	-
Fe	-	-	70	160[e]	240[e]	50	-	-	-	-
Co	-	-	<1000	-	-	<10	-	-	-	-
Ni	-	-	<200	-	-	<10	-	-	-	-
Zn	-	-	-	<20[e]	<20[e]	<20	-	-	-	-
As	-	-	<2000	-	-	-	-	-	-	-
Sr	-	-	<200	-	-	<20	-	-	-	-
Cd	-	-	<1000	-	-	<10	-	-	-	-
Sn	-	-	<2000	-	-	<40	-	-	-	-
Ba	-	-	<200	-	-	<0.2	-	-	-	-
La	-	-	<2000	-	-	<10	-	-	-	-
Ce	-	-	<10000	300[e]	300[e]	<20	-	-	-	-
Hg	-	-	<4000	<20[e]	<20[e]	<20	-	-	-	-
Pb	-	-	<1000	39[e]	60[e]	<10	-	-	-	-
Bi	-	-	<1000	-	-	-	-	-	-	-
Th	-	-	<1000	-	-	-	-	-	-	-
U	-	-	<10000	-	-	<10	-	-	-	-
B	-	-	-	-	-	-	7.4[e]	6.1[e]	2.9[e]	5.2[e]
α-n/sec. per gram	-	-	-	-	-	-	2.05	2.77	2.44	2.49

[redacted]

[redacted]

TABLE III (Cont'd)

Site Y Lot No.	274-P	274-P	275-P	276-P	277-P	278-P	279-P
Li	-	-	-	-	-	<18	<2
Be	-	-	-	-	-	<0.25	<0.25
P	<25	<25	<50	<50	<50	<64	<50
S as $SO_4^{=}$	<18,000	<18,000	<15,000	<15,000	<15,000	<14,000	<15,000
Na	-	-	-	-	-	<45	<50
Mg	-	-	-	-	-	<5	<5
Al	-	-	-	-	-	9	50
K	-	-	-	-	-	<18	<20
Ca	170	70	80	60	150	270	220
Cr	220	220	240	210	300	450	420
Mn	-	-	-	-	-	<5	<5
Fe	150	240	157	88	140	274	100
Co	-	-	-	-	-	<23	<25
Ni	7	10	10	8	20	<23	<25
Zn	-	-	-	-	-	<30	<100
Cr	-	-	-	-	-	<0.5	<0.5
Cd	-	-	-	-	-	<45	<50
Sn	120	70	100	100	200	160	150
Ba	-	-	-	-	-	11	10
La	<3	<3	<2	<2	<2	<5	<5
Ce	-	-	-	-	-	<45	<50
Pb	-	-	-	-	-	<45	<50

[redacted]

[redacted]

[redacted]

TABLE III-A

Purity of Metal

Notes on the Headings

All elements have been reported as parts per million parts of plutonium.

a See Table V.

b For a complete explanation of method, see report La 405.

c The "average" figure which is reported is that value below which 90% or more of the determinations fell.

d The number is the total number of determinations used to compute the "average" value.

e A dash indicates that the datum was not requested or not reported.

f The sample was a combination of A and B process lots.

[redacted]

	5965-E[a]	7057-B	7063-B	7064-C	7082-A	7085-A	7099-A	7108-A	7115-A	7130-A
Method[b]	A	A	A	A	A	A	A	A	A	A
Li	<0.8	<1	<1	<0.8	<1.1	<0.9	<0.9	<1	<1.1	<1
Be	<0.08	<0.1	<0.1	<0.08	<0.11	<0.09	<0.09	<0.1	<0.11	<0.1
B	1.2	3	0.7	-[c]	1	<0.5	<0.5	<0.5	<0.5	0.5
C	130	250	225	-	-	-	-	-	-	-
O	-	-	-	-	-	395	-	-	<100	-
F	<3	-	-	-	-	-	-	-	<9	-
Na	3	<9	<3	<3	<11	9	14	8	11	<9
Mg	3	3	4	<2	<2	4	17	8	5	4
Al	24	19	16	5	5	180	9	29	9	17
Si	-	-	200	-	-	-	-	-	-	-
K	<32	<42	<41	<31	<45	<36	<35	<38	<45	<34
Ca	4	17	41	6	11	6	170	11	18	~350
V	-	-	-	-	-	-	-	-	-	-
Cr	-	-	-	-	-	-	-	-	-	-
Mn	-	-	-	-	-	-	-	-	-	-
Fe	-	-	-	-	-	-	-	-	-	-
Co	-	-	-	-	-	-	-	-	-	-
Ni	-	-	-	-	-	-	-	-	-	-
Cu	-	-	-	-	-	-	-	-	-	-
Zn	-	-	-	-	-	-	-	-	-	-
Sr	-	-	-	-	-	-	-	-	-	-
Cd	-	-	-	-	-	-	-	-	-	-
In	-	-	-	-	-	-	-	-	-	-
Sb	-	-	-	-	-	-	-	-	-	-
Ba	-	-	-	-	-	-	-	-	-	-
La	-	-	-	-	-	-	-	-	-	-
Ce	-	-	-	-	-	-	-	-	-	-
Hg	-	-	-	-	-	-	-	-	-	-
Pb	-	-	-	-	-	-	-	-	-	-
Bi	-	-	-	-	-	-	-	-	-	-
U	-	-	-	-	-	-	-	-	-	-

[redacted]

This document contains [redacted]

[redacted]

	7170-A	7177-A	7193-A	7201-A	7205-A	7206-A	7244-A	7155-A	7161-A
	A	A	A	A	A	A	A	B	B
	<1.2	<1.2	<0.8	<1.2	<0.9	<1.2	<1.9	<1	<1.2
	<0.08	<0.12	<0.08	<0.12	<0.09	<0.12	<0.1	<0.1	<0.12
	0.4	0.4	0.7	<0.5	<0.5	<0.5	0.9	0.3	0.4
	-	-	-	-	-	-	-	-	-
	-	-	100	-	-	-	-	-	-
	-	-	<3	-	-	-	-	-	-
	[redacted]	[redacted]	<3	9	7	<3	20	14	
	[redacted]	<3	45	2500	95	75	95	4	35
	[redacted]	7	5	8	19	5	37	9	9
	[redacted]	[redacted]	-	-	-	-	-	~300	~200
	[redacted]	[redacted]	<32	<35	<19	<24	<15	<40	<46
	70	<7	150	150	95	145	85	<3	<7
	[redacted]	[redacted]	-	-	-	-	-	<30	<60
	[redacted]	[redacted]	-	-	-	-	-	<2	<2
	[redacted]	[redacted]	-	-	-	-	-	<2	<2
	[redacted]	[redacted]	-	-	-	-	-	226	186
	[redacted]	[redacted]	-	-	-	-	-	<10	<12
	[redacted]	[redacted]	-	-	-	-	-	<4	12
	[redacted]	[redacted]	-	-	-	-	-	<60	<60
	<46	-	-	-	-	-	-	<40	<46
	<4.1	-	-	-	-	-	-	15	15
	<11	-	-	-	-	-	-	<10	<12
	[redacted]	-	-	-	-	-	-	15	15
	[redacted]	-	-	-	-	-	-	<60	<60
	<3	-	-	-	-	-	-	<2	<2
	[redacted]	-	-	-	-	-	-	8	9
	<23	-	-	-	-	-	-	<20	<23
	<23	-	-	-	-	-	-	<150	<23
	<11	-	-	-	-	-	-	<15	<15
	[redacted]	-	-	-	-	-	-	<100	<12
	60	-	-	-	-	-	-	40	20

[redacted]

[redacted]

TABLE XXXI-A (Cont'd)

[redacted]

[redacted]	7367-A	7376-A	7389-A	7502-A	7528-A	7550-A	7574-A	7581-A	7140-A	7144-A
[redacted]	B	B	B	B	B	B	B	B	C	C
[redacted]	[redacted]	[redacted]	[redacted]	<0.2	<0.2	<0.2	<.15	<0.16	<0.8	<0.9
[redacted]	[redacted]	[redacted]	[redacted]	<0.1	<0.1	<0.08	<.15	<0.16	<0.08	<0.09
[redacted]	[redacted]	[redacted]	[redacted]	<0.5	0.7	<0.5	0.7	<0.5	0.4	0.5
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	-	-
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	-	-
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	-	-
[redacted]	[redacted]	[redacted]	[redacted]	<3	<3	<3	<1.9	63	19	18
[redacted]	[redacted]	80	80	29	2	7	3.8	160	2	2
[redacted]	[redacted]	14	59	6	5	19	24	<2	7	
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	~300	~300
[redacted]	[redacted]	<22	<20	<21	<17	190	160	<31	<36	
[redacted]	[redacted]	78	58	<1	67	114	125	16	<6	
[redacted]	[redacted]	[redacted]	-	-	-	-	-	-	<30	<30
[redacted]	[redacted]	[redacted]	-	-	-	-	-	-	<2	<2
[redacted]	[redacted]	[redacted]	-	-	-	-	-	-	<2	<2
[redacted]	[redacted]	[redacted]	-	-	-	-	-	-	99	149
[redacted]	[redacted]	[redacted]	-	-	-	-	-	-	<8	<9
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	<5	~10
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	<60	<60
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	~160	180
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	2	1.2
[redacted]	[redacted]	-	-	-	-	-	-	-	<8	<9
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	~60	~30
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	<60	<60
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	<2	<2
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	1300	~400
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	160	90
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	<16	<18
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	<8	<9
[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	-	<100	<100
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	-	-	-	-	20	10

[redacted]

[redacted]

[redacted]

[redacted]

Summary

	A[b]		B[b]		C[b]	
	Average[c]	Number[d]	Average[c]	Number[d]	Average[c]	Number[d]
Li	<1.7	17	<1.2	10	<0.9	2
Be	<1.2	18	<.16	10	<0.09	2
B	1	16	0.7	10	0.5	2
C	250	3	-	-	-	-
O	395	2	-	-	-	-
F	<9	3	-	-	-	-
Na	12	18	21	10	20	2
Mg	80	17	60	9	3	2
Al	30	18	25	10	8	2
Si	200	2	300	3	300	2
K	<46	18	165	10	<36	2
Ca	160	18	125	10	17	2
V	<300	1	<60	2	<30	2
Cr	<2	1	<2	2	<2	2
Mn	<2	1	<2	2	<2	2
Fe	22*	2	227	2	150	2
Co	<11	1	<12	2	<9	2
Ni	<6	1	15	2	11	2
Cu	<6	1	<60	2	<30	2
Zn	<46	1	<46	2	185	2
Sr	<1.1	1	<1.2	2	3	2
Cd	<11	1	<12	2	<9	2
Sn	26	1	16	2	65	2
Sb	<25	1	<60	2	<60	2
Ba	<2	1	<2	2	<2	2
La	6	1	10	2	1350	2
Ce	<23	1	<23	2	165	2
Hg	<23	1	<150	2	<18	2
Pb	<11	1	<15	2	<9	2
Bi	-	-	<100	2	<100	2
U	60	1	41	2	25	2

[redacted]

[redacted]

[redacted]

TABLE IV

Comparison of A, B, and C Processes

Notes on the Headings

All elements have been reported as parts per million parts of plutonium.

The product from five experimental purification runs was analyzed thoroughly at certain stops in its processing, and the results tabulated in Table IV. The first value reported is the amount of impurity present in the last oxalate; the second, the amount present in the product after hydroflourination; the third, the amount present in the metal after reduction and remelt.

a For a complete explanation of processes, see report LA 405.

b A dash indicated that the datum was not requested or not reported.

	A[a]								
	574-P			576-P			577-P		
	Oxalate	Flouride	Metal	Oxalate	Flouride	Metal	Oxalate	Flouride	Metal
Li	<0.31	-[b]	<1.1	-	-	<1	<0.6	-	<1.2
Be	<0.4	<0.14	<0.11	<0.6	<0.2	<0.1	<0.08	<0.2	<0.12
B	0.2	-	0.4	<0.3	-	0.3	<0.3	-	0.4
Na	12.5	-	<11	-	-	20	3	-	14
Mg	≤0.4	3	7	≤6	<4	4	<2	≤4	35
Al	16	~7000	7	-	~2000	9	<2	~2200	9
Si	<700	-	100	≤120	-	~300	<120	-	~200
P	<31	-	-	<43	-	<600	<65	-	-
K	<31	-	<45	-	-	<40	<33	-	<46
Ca	40	56	<7	220	600	<6	<2	88	<7
V	<150	-	<300	<60	-	<30	<60	-	<60
Cr	<16	11	<2	<22	<4	<2	<2	<4	<2
Mn	<4	0.3	<2	<5	4	<2	<2	≤4	<2
Fe	15.3	-	183	16.3	-	226	-	-	186
Co	<20	<14	<11	<22	<20	<10	<8	-	<12
Ni	<16	14	<5	<22	20	<4	8	22	12
Cu	<60	-	<6	-	-	<60	-	-	<60
Zn	-	<56	<45	-	-	<40	<33	-	<46
Sr	-	3	<1.1	-	4	<1	-	2	<1.2
Cd	-	<14	<11	-	<40	<10	<8	44	<12
In	-	-	-	<30	-	<30	<30	-	-
Sn	-	<14	25	-	40	15	<8	66	15
Sb	<100	-	<25	<60	-	<60	<60	-	<60
Ba	16	28	<2	43	120	<2	<2	88	<2
La	9	23	5	<5	4	8	<2	<4	9
Ce	-	<28	<23	-	<80	<20	<17	<88	<23
Hg	<150	-	<23	-	<40	<150	<17	<44	<23
Tl	-	-	-	<100	-	-	<100	-	-
Pb	<24	28	<11	36	40	<15	<8	≤44	<15
Bi	-	-	-	-	-	<100	-	-	<12
U	-	-	60	-	-	40	-	-	20

[redacted]

[redacted]

[redacted]

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	Ca					
	570-P			571-P		
	Oxalate	Flouride	Metal	Oxalate	Flouride	Metal
Li	<0.44	-	<0.8	<0.48	-	<0.9
Be	<0.44	<0.14	<0.08	<0.48	<0.2	<0.09
B	<0.3	-	0.4	<0.3	-	0.3
Na	180	-	19	160	-	15
Mg	90	6	2	38	<4	2
Al	22	~7000	<2	24	~800	7
Si	~250	-	~300	~400	-	~300
P	<40	-	-	<48	-	-
K	<44	-	<21	40	-	<36
Ca	440	110	16	240	<12	<6
V	<150	-	<30	<150	-	<30
Cr	<4.4	.14	<2	<4.8	<4	<2
Mn	<4.4	6	<2	<4.8	<4	<2
Fe	300	-	99	125	-	149
Co	4.4	<14	<8	<4.8	<20	<9
Ni	<44	110	<3	<48	20	~10
Cu	<<30	-	<60	<<30	-	<60
Zn	-	<55	160	-	-	180
As	44	3	-	-	-	-
Sr	-	-	2	24	<2	1.2
Cd	<44	<14	<8	<48	<40	<9
In	<30	-	-	<30	-	-
Sn	200	14	~60	150	<40	~30
Sb	<150	-	<60	<150	-	<60
Ba	44	42	<2	38	12	<2
La	2200	~6600	1300	1420	330	~400
Ce	<44	<28	160	48	<80	90
Hg	44	-	<16	48	<130	<18
Pb	<30	28	<8	<30	<41	<9
Bi	<100	-	<100	<100	-	<100
Th	<150	-	-	-	-	-
U	~130	-	20	~130	-	10

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TABLE [redacted]

Sample	Method[a]	Composition - Purification Lots
5965-E	A	?
7057-B	A	?
7063-B	A	67% 513-P, 67% 514-P, 67% 515-P, 67% 516-P, 67% 517-P, 33% 518-P, 33% 519-P 525-P.
7064-C	A	?
7082-A	A	531-P, 536-P, 538-P, 541-P, 542-P.
7085-A	A	533-P, 537-P, 543-P, 544-P.
7099-A	A	551-P, 552-P, 553-P, 554-P, 555-P.
7105-A	A	556-P, 557-P, 558-P, 559-P.
7115-A	A	560-P, 561-P, 562-P, 563-P.
7130-A	A	564-P, 565-P, 566-P, 567-P.
7159-A	A	574-P.
7170-A	A	581-P, 582-P, 583-P.
7177-A	A	584-P, 585-P, 586-P, 587-P.
7193-A	A	592-P, 593-P, 594-P, 595-P, 598-P, 598-P.
7201-A	A	588-P, 589-P, 590-P, 591-P, 599-P.
7203-A	A	600-P, 601-P, 602-P, 603-P.
7205-A	A	604-P, 605-P, 606-P, 607-P.
7244-A	A	622-P, 623-P, 624-P, 625-P.
7155-A	B	576-P.
7161-A	B	577-P.
7267-A	B	633-P, 634-P, 635-P, 636-P, 637-P, 638-P, 33% 639-P, 33% 640-P, 67% 641-P, 33% 642-P, 67% 643-P, 67% 644-P.
7276-A	90% B 10% A	33% 641-P, 33% 642-P, 33% 644-P, 645-P, 646-P, 647-P, 648-P, 649-P, 650-P, 654-P, 655-P, 656-P, plus 10% from an unknown A lot.
7289-A	B	651-P, 652-P, 657-P, 658-P, 659-P, 660-P, 661-P, 662-P, 663-P, 664-P, 665-P, 666-P.
7302-A	B	667-P, plus 10% from an unknown B lot.
7326-A	B	50% 671-P, 50% 672-P, 50% 673-P.
7350-A	B	668-P, 669-P, 670-P, 50% 671-P, 50% 672-P, 50% 673-P, 676-P, 677-P, 678-P, 680-P, 681-P, 682-P.
7374-A	B	679-P, 683-P, 684-P, 685-P, 686-P, 687-P, 688-P, 689-P, 690-P, 67% 691-P, 67% 692-P, 67% 693-P.
7381-A	B	694-P, 695-P, 696-P, 50% 697-P, 50% 698-P, 50% 699-P.
7140-A	C	570-P.
7144-A	C	571-P.

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