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MANHATTAN DISTRICT HISTORY

BOOK V - ELECTROMAGNETIC PROJECT

VOLUME 6 - OPERATIONS

TOP SECRET APPENDIX

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MANHATTAN DISTRICT HISTORY

BOOK V - ELECTROMAGNETIC PROJECT

VOLUME 6 - OPERATIONS

TOP SECRET-APPENDIX

TABLE OF CONTENTS

Par. No.		Page No.
	Status of Electromagnetic Project as of 31 December 1946	
1	Initial Operations	1
2	Production Operations	
	(a) Alpha Production	1
	(b) Beta Production	1
	(c) Process Waste	2
3	Efficiency of Operations	3
		3

APPENDIX

[illegible] automatic downgrading [illegible] declassification.

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Operations [illegible] Data
Clearance required.

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MANHATTAN DISTRICT HISTORY

BOOK V - ELECTROMAGNETIC PROJECT

VOLUME 6 - OPERATIONS

TOP SECRET APPENDIX

Status of Electromagnetic Project as of 31 December 1946.

1. Initial Operations - During the latter part of 1943, the Alpha Section (XAX) in the Pilot Plant, Building 9731, was in operation. Vacuum testing started 7 August 1943 with nine men on three shifts. This operation had for its primary objective the training of the initial personnel required to operate the Alpha I buildings and at the same time acquire as much knowledge as possible of the equipment and its characteristics; for organizational purposes, it was necessary to acquire a knowledge of the people, their abilities, and their characteristics.

2. Production Operations - The several production units began to operate, beginning on 22 January 1944 and continued as indicated in the schedule shown in the following table:

Alpha Track No. 1	- 13 November 1943 (1st Temporary Start)
	- 3 March 1944
Alpha Track No. 2	- 22 January 1944
Alpha Track No. 3	- 19 March 1944
Alpha Track No. 4	- 12 April 1944
Alpha Track No. 5	- 3 June 1944
Alpha Track No. 6	- 24 July 1944
Alpha Track No. 7	- 26 August 1944
Alpha Track No. 8	- 24 September 1944
Alpha Track No. 9	- 26 October 1944
Beta Track No. 1	- 15 March 1944
Beta Track No. 2	- 5 June 1944
Beta Track No. 3	- 12 September 1944
Beta Track No. 4	- 2 November 1944
Beta Track No. 5	- 30 January 1945
Beta Track No. 6	- 13 December 1944
Beta Track No. 7	- 1 December 1945
Beta Track No. 8	- 15 November 1945

Two years and two days elapsed from the starting of Alpha Track No. 1 and Beta Track No. 8.

a. Alpha Production - The feed material for the Alpha Stage was received by year as indicated below:

[redacted]

[redacted]

Year	Kg. U-235	% U-235	Kg. U
1943	53.23	.71	7,513.51
1944	907.38	.71	127,854.13
1945	779.18	.77 (Avg)	[illegible]
1946	--	--	--
Total	1,740.34	[illegible] (Avg)	[illegible]

This material for feed was received in the form of trioxide, tetrachloride, dioxide, pentachloride, hexafluoride, a small amount of residues, salvage from Beta and a large amount of miscellaneous material from U.S.E.D. The chief sources were Mallinckrodt, Harshaw, Porcelave, Vitrified Products Corporation, and U.S.E.D.

The uranium was removed from the Alpha Cycle as follows:

Year	Kg. U-235	% U-235	Kg. U
1943	--	--	--
1944	425.43	.71	51,41[illegible].51
1945	1,314.91	.78	172,41[illegible].77
1946	--	--	--
Inventory as of 6/2/46	0.73	.41	1[illegible].16
Total	1,741.07	.74	[illegible]
Material unaccounted for	242.34	.44	37,7[illegible].54 (15.[illegible] of total)

Of the amount removed from Alpha Cycle there was added to the Beta Cycle as follows:

Year	Kg. U-235	% U-235	Kg. U
1943	--	--	--
1944	23.129	[illegible]	[illegible]
1945	72.728	[illegible]	[illegible]
1946	--	--	--
Total	95.357	[illegible]	[illegible]

Minus total amount, 3.49 Kg. of Uranium containing .327 Kg. U-235 was unaccounted for in refining Oxide. 168,198.96 Kg. of unused feed material was returned to the U.S.E.D.

b. Beta Production - The production, based on 100% U-235, of the Beta stage from the beginning of operations thru 29 December 1946, appear in the following table:

All production to 0700 1 January 1945	6,890.1
0700 1 January 1945 to 0700 30 December 1945	[illegible]
0700 30 December 1945 to 0700 29 December 1946	[illegible]
Total to Date 29 December 1946 [redacted]	[illegible] grams

c. Process Waste - The waste from process was of three types: one in solution and of such low concentration that it would not be possible to economically concentrate and recover; this was turned over to the Government (U.S.E.D.) to be disposed of by storing in a reservoir for same; the second in solid salvage and so low in concentration that it could not be economically recovered by strong acid or by destructive flourination of the solids; the third constituting a relatively small amount that was adhering to equipment in such a manner that it could not be removed without destroying the equipment.

3. Efficiency of Operation - The efficiency of the operation is best seen by a comparison of the X and T utilization figures, when

X* utilization efficiency, $\frac{RX^*}{RX + QX + \text{Discarded Salvage X} + \text{Unaccounted-for X}}$

T* utilization efficiency, $\frac{RT + QT}{RT + QT + \text{Discarded Salvage T} + \text{Unaccounted-for T}}$

Year	XUE	TUE
1944	65.0%	74.0%
1945	91.7%	93.3%

* Q - ionized material received and collected in the U-238 section, or the Q pocket of the Receiver.

* R - Ionized material received and collected in the U-235 section, or the R pocket of the Receiver.

* X - Is U-235

* T - Is total Uranium formerly referred to as Tuballoy and includes all uranium isotopes.

Therefore, RX is X received in R pocket,
QX is X received in Q pocket,
RT is total U found in R pocket, and
QT is total U found in Q pocket.

Because of certain changes in design, an XPE of 24.5% was averaged on 19 runs. This represents over 100% increase in production per unit, within the past year.

The over-all losses have aggregated 17.4% of the amount received in Alpha Plant and 5.4% of the amount received in the Beta Plant.

Another efficiency is based on the ratio of the amount of U-235 collected to the amount in the vaporized charge material. This XPE* is shown as follows:

[redacted]

Year	X.P.E.
1943	--
1944	--
1945	11.7
1946	14.9

*XPE-U-235 Process Efficiency.

The production of U-235 by the electromagnetic process is shown as accumulated totals and percent concentration of the U-235.

BETA PRODUCTION THROUGH 1946 in U-235.

Accumulated Totals in Grams

Date	Total in Grams	R X C %
10-7-44	1,747.7	67.5
10-21-44	2,293.4	68.9
10-28-44	2,589.1	69.3
11-19-44	3,830.6	70.6
3-4-45	20,390.34	77.2
3-25-45	24,919.06	78.1
4-22-45	30,541.16	79.0
5-20-45	35,638.19	79.9
7-17-45	52,506.91	81.6
8-12-45	66,734.14	82.6
9-9-45	88,201.34	84.5
12-2-45	182,143.55	88.9
12-30-45	231,458.28	90.1
~~12-31-46~~	~~1,045,009.00~~	Approx. 95%
12-29-46	1,041,026.5	

[redacted]

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MANHATTAN DISTRICT HISTORY

BOOK V - ELECTROMAGNETIC PROJECT

VOLUME 6 - OPERATIONS

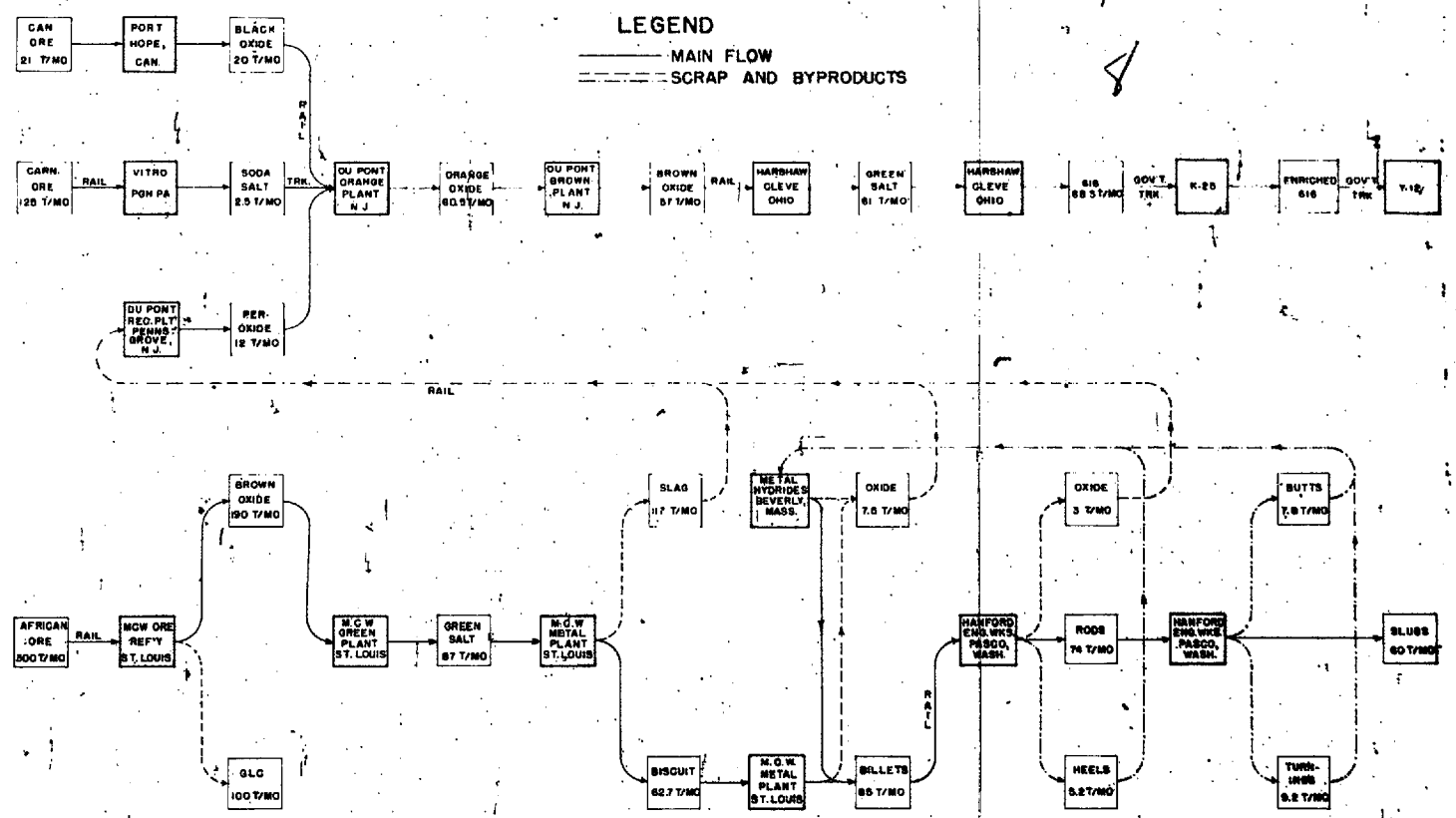
TOP SECRET APPENDIX

APPENDIX

~~Par. No.~~		~~Page No.~~
1	Uranium Production Flow Diagram	
2	Y-12 Flow Chart	
3	Alpha Chemistry Flow Chart	
4	Beta Chemistry Flow Chart	
5	Shipment of U 235 from Electromagnetic Plant	
6	Principle and Functioning of the Mass Spectrograph	

[redacted]

URANIUM PRODUCTION FLOW DIAGRAM



Y-12 PROJECT

CONCENTRATION OF URANIUM ISOTOPE 235 BY MASS SPECTROGRAPH

FEED MATERIALS PRESENT	FIRST CHEMICAL PROCESSING	FIRST MASS SPECTROGRAPH CONCENTRATION	SECOND CHEMICAL PROCESSING	SECOND MASS SPECTROGRAPH CONCENTRATION	FINAL CHEMICAL PROCESSING
	ALPHA CHEMISTRY	ALPHA PROCESS	BETA CHEMISTRY	BETA PROCESS	BETA PRODUCT CHEMISTRY
	URANIUM COMPOUNDS CONVERTED TO URANIUM TETRACHLORIDE AND LOADED INTO CHARGE CONTAINER FOR USE AS FEED IN ALPHA PROCESS	[illegible] TETRACHLORIDE [illegible] FEED AND CONCENTRATED [illegible] PRODUCT	ALPHA PRODUCT IS PURIFIED AND CONVERTED TO URANIUM TETRACHLORIDE FOR USE AS FEED IN BETA PROCESS	[illegible] IS [illegible]	[illegible] URANIUM TETRAFLUORIDE

~~FUTURE~~

URANIUM HEXAFLUORIDE
FROM K-25 (20-25% ISOTOPE 235)

ALPHA FEED
BETA FEED
BETA PRODUCT
FUTURE FEED

ALPHA CHEMISTRY

TOP

URANIUM TETRACHLORIDE REMAINING IN CHARGE CONTAINERS

URANIUM HEXAFLUORIDE FROM K-25

CONVERSION OF URANIUM HEXAFLUORIDE TO URANIUM TRIOXIDE

PREPARATION OF CRUDE URANIUM TETRACHLORIDE

PURIFICATION OF THE CRUDE URANIUM TETRACHLORIDE

FILLING OF CHARGE CONTAINERS FOR ALPHA PROCESS

ALPHA PROCESS

URANIUM HEXAFLUORIDE FROM S-50

CRUDE URANIUM TETRACHLORIDE

URANIUM TRIOXIDE FROM MADISON SQUARE AREA

0·71% URANIUM 235

RECOVERY OF URANIUM TRIOXIDE FROM WASH SOLUTION

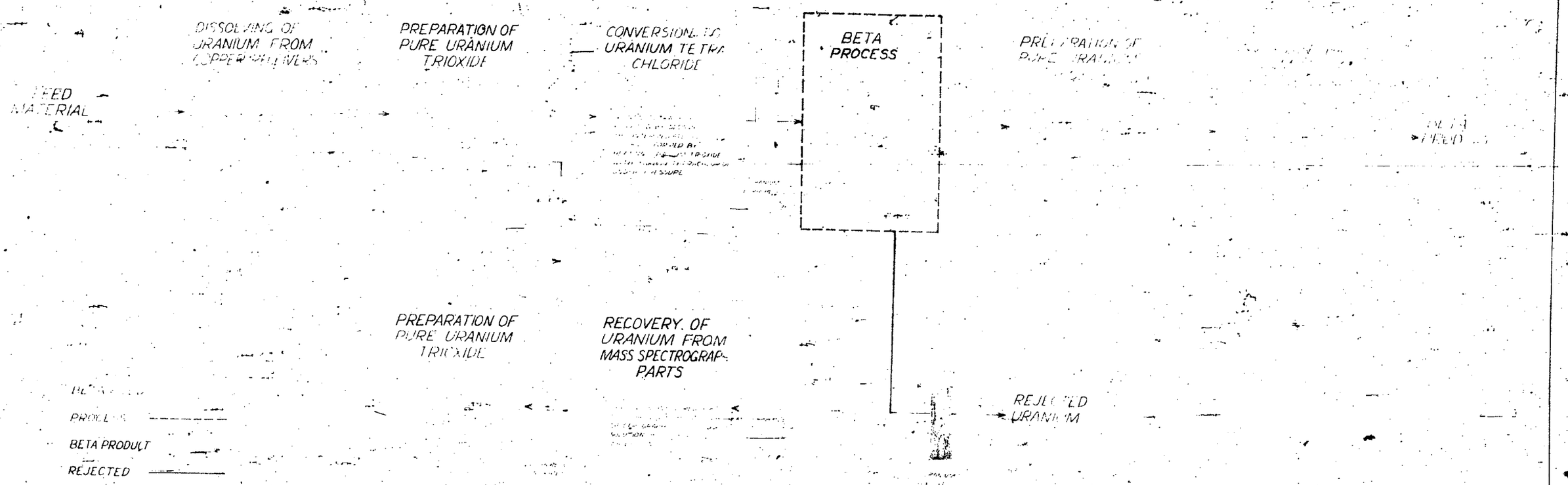
RECOVERY OF URANIUM FROM MASS SPECTROGRAPH PARTS

ALPHA FEED PROCESS

TOP

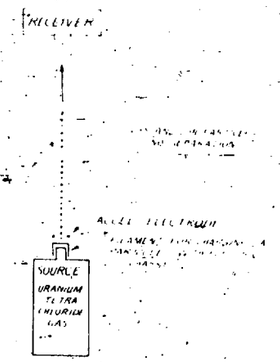
BETA CHEMISTRY

BETA PRO[illegible] CHEMISTRY

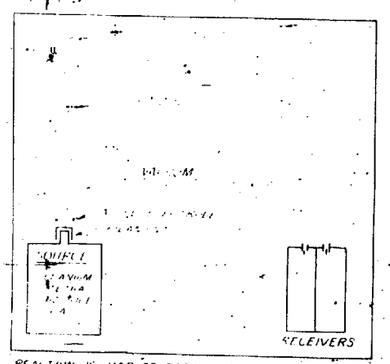


PRINCIPLE AND FUNCTIONING OF MASS SPECTROGRAPH

FUNDAMENTAL THEORY
REASON FOR USE OF MAGNETIC FIELD

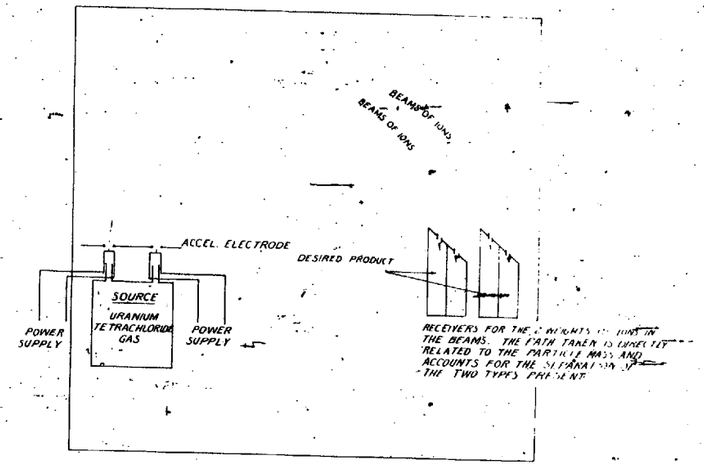


REACTION OF CHARGED PARTICLES OF GAS IN VACUUM WITHOUT MAGNETIC FIELD NO SEPARATION OF DIFFERENT MASSES TAKES PLACE

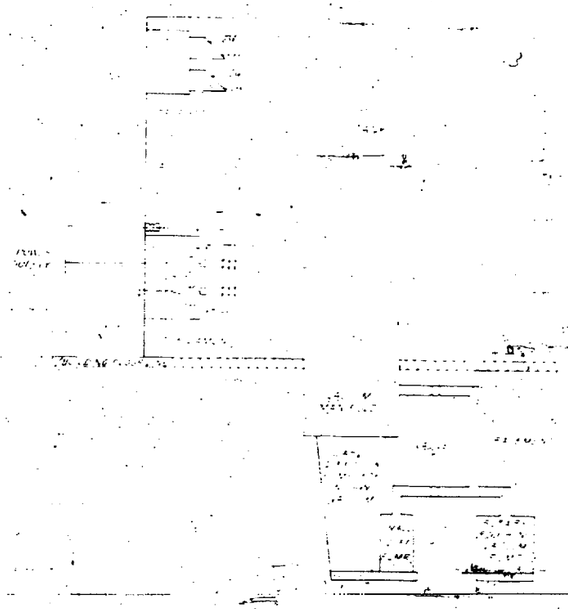


REACTION OF CHARGED PARTICLES OF GAS OF DIFFERENT MASSES WHEN OPERATION IS PERFORMED IN PRESENCE OF MAGNETIC FIELD. THE MAGNETIC FIELD CAUSES PARTICLES OF DIFFERENT MASSES TO FOLLOW DIFFERENT PATHS AND THUS EFFECTS SEPARATION OF PARTICLES OF U_{235} AND U_{238}

FUNDAMENTAL MASS SPECTROGRAPH SYSTEM AS APPLIED TO Y-12 PROJECT



ONE PRODUCTION UNIT OF A Y-12 - RACE TRACK SIDE VIEW

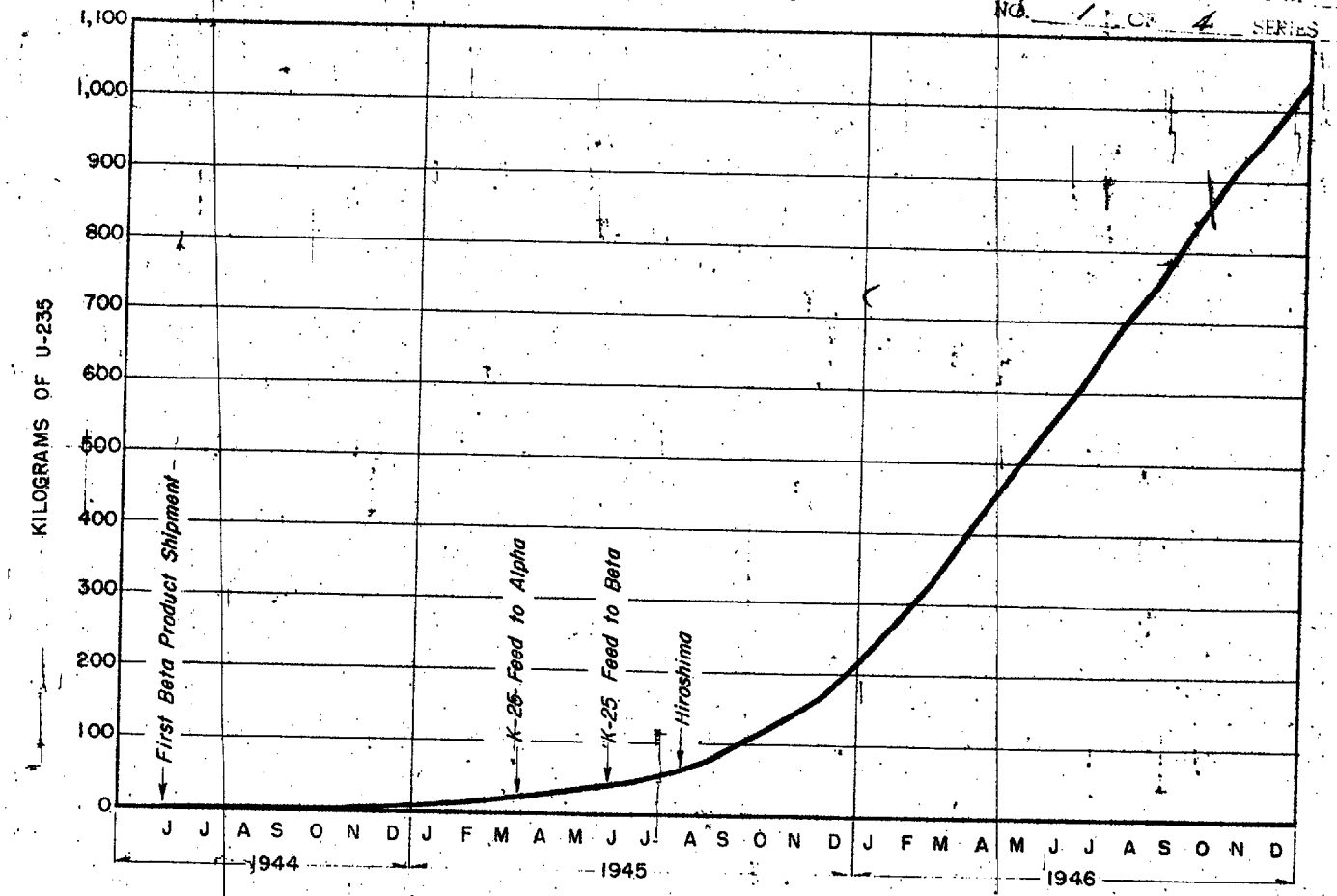


VI-7

CUMULATIVE SHIPMENTS OF U-235 FROM ELECTROMAGNETIC PLANT TO LOS ALAMOS 1944-1946

TOP SECRET
BY AUTHORITY OF THE ATOMIC ENERGY COMMISSION
6/15/48

THIS DOCUMENT CONSISTS OF 1 PAGES
NO. 1 OF 4 SERIES A



[redacted] SECRET

Ref. Ltr dtd Apr. 20, 1955 - Rpt change to consolidate page 13 of VI-7-1a to VI-6-1a - from Oak Ridge

Ltr dtd May 9, 1955 - authority to change page 13 - Consolidate page 13 of VI-7-1a to VI-6-1a - from AEC

Letter also filed in AEC correspondence file in TSC office as of 24 May 55 -

VI-7-1A incorporated into VI-6-1A as page 13 per Oak ltr 5/9/55. VI-7-1A will hereafter be reported as a separate document to Oak in S.A. mntgs.

M. Dawson
6/27/57

[redacted]