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HW 24612-RD

2. PFG 431
3-J

Classification Canceled and Changed To

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TO: R. B. Richards

FROM: J. B. Work *JBW*

By Authority of CG-PR-2

DS Lewis 4-10-90

By M. Eick 12-14-93

Verified By J. N. Wells 12-15-93

25 CONTENT OF INITIAL LOTS OF HANFORD UO₃

COPY 1 OF 1, ~~SECRET~~ MA

At the time the first UO₃ from so-called "full level" Redox runs was shipped from 224U, the % U₂₃₅ as determined in 222-S appeared high when compared with theoretical values from the burn-out curve. Close agreement between the 222-S results and % U₂₃₅ determined by K-25 on lots 007, 008, and 009, however, indicated that a considerable heel of cold uranium in Redox had been blended with the first "full level" material. This explanation has been verified by data collected over the past weeks and assembled below, primarily for the information of P. F. Gast and yourself. It has also been verified by the % U₂₃₅ found in lots later than 010* (after most of cold uranium flushed out of Redox) which ranged from 0.66% to 0.64%.

The first two items in the appended tabulation show the material balance across Redox while the next two show the same for 224U and item V gives overall balance. While the direction of the discrepancy is surprising, the conclusions of later items are not influenced by material balance appreciably. Item VI indicates the method of obtaining the weighted average MWD/t for hot material shipped to 224U. Item VII tabulates the total U₂₃₅ content of shipments from 224U, corrects this for the natural uranium fed first, and computes an average % U₂₃₅ on the remainder which represents the hot material received by 224U. This is seen to check fairly well with the theoretical % U₂₃₅ for that exposure. Finally, item VIII shows numerically how the cold metal heel from Redox "diluted" the first few lots of "nominal 600 MWD/t" uranium shipped by 224U.

The separate items are supported as indicated by detailed breakdown on later sheets. Plutonium values have been omitted for security reasons and because U₂₃₅ was the major concern.

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* Recent information obtained after these data had been compiled indicates that Hanford results on lots 010 thru 013 were significantly higher than K-25 analyses, but good checks were obtained on lots 014 through 025.

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HWL-24612-RD

- 2 -

	<u>Tons U</u>	<u>M&D</u>
I - Feed charged to Redox thru 3/28/52 (See Detail A)		
A - Cold metal (note: partly saved for "5%" runs)		
1 - Hanford Slugs	21.6	--
2 - Clinton Slugs	0.41	<1
B - Hot metal (ca. 1363# U went to "5%" runs)	<u>85.62</u>	<u>50,104</u>
C - Total	107.63	50,104
II - Accounted for by Redox		
A - To waste thru 3/28/52		
1 - Cold and 5% runs	0.22	--
2 - Hot runs	0.66	387(a)
3 - Sub-total	0.88	387(a)
B - Inventory on 3/28/52 (See Detail B)		
1 - Sub - total	32.39	19,472
C - Shipped to 224U thru 3/28/52		
1 - Sub-total from Redox	<u>73.0</u>	<u>30,245(b)</u>
D - Total accounted for	106.27	50,104
1 - % of feed	98.7%	--
III - Feed charged to 224U thru 4/1/52 (See Detail C)		
A - Cold	11.07	--
B - "5%"	9.46	--
C - Hot	<u>64.95</u>	<u>--</u>
D - Total	85.48	--

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Hw 24612-RD

- 3 -

	<u>Tons U</u>	<u>Lbs 235</u>
IV - Accounted for by 224U (See Detail D)		
A - To Mallinckrodt (Test Lots 001T thru 004T)	5.20	
B - "Cold" plus "5%" runs (to K-25)	15.37	
C - "Full level" runs (to K-25)	53.51	
D - Inventory on 3/31/52 (See Detail E)	<u>5.96(c)</u>	
E - Total accounted for	80.04	
1 - % of feed	93.5%	
V - Overall accounting on U		
A - Charge	111.46	
B - Recovered plus inventory plus waste	103.79	
C - % recovered	93 %	
VI - MWD/t		
A - Average on feed to Redox (50,104/85.62) =	585	
B - Estimated ave. on Redox inventory (19,472/32.39) =	601	
C - Weighted ave. on shipments to 224U (30631/53.23) =	575(d)	
VII - Estimation of U ₂₃₅ ratio		
A - Shipped from 224U	74.07	996.2
1 - Deduct cold metal fed to Redox(e)	21.79	309.7
2 - Deduct cold metal from 321 Bldg.	3.83	54.5
B - Balance (hot metal shipped from 224U)	48.46	632.0
C - % 25in Balance (632.0 x 100/48.46 x 2000) =	0.652%	
1 - Cf. theor. figure for 575 MWD/t	0.645%	

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HW 24612-AD

VIII - Explanation of high U_{235} in UO_3 lots 007 thru 010

A - Total metal used in Redox on cold and 5% runs,

corrected for waste losses

21.79 Tons

1 - Total received by $224U$ from Redox for lots

thru 006

16.7 Tons

2 - Cold metal held-up in Redox

5.1 Tons

B - Receipts (cold and 5%) by $224U$

1 - From Redox

16.7 Tons

2 - From 321

3.8 Tons

3 - Total

20.5 Tons

C - Shipped (cold and 5%) by $224U$

20.56 Tons

1 - No hold-up in $224U$ of cold U

D - If the 5.1 Ton hold-up in Redox, blended with ca 6.56 tons of first

fulllevel material to give lots 007-010 (11.66 Tons), and if "full"

level stuff is 0.645% U_{235} , would expect $\frac{5.1 \times 0.711 + 6.56 \times 0.645}{11.6} = 0.677\%$

U_{235} in blend.

1 - Actually, lots 7 & 8 had 0.68% and 9 & 10 had 0.67%

2 - This check is closer than the data are good for.

(a) Estimated

(b) By difference

(c) This does not include the so-called "Hold-up" which $224U$ accountability carries on books instead of "unaccounted for" and which amounted to 4392 lbs U after lot 025.

(d) Based on MWD and Tons charged to Redox less MWD and Tons in inventory, not on actual tons transferred.

(e) This has been corrected for the 0.22 Tons waste in Redox processing.

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DETAIL A

REDOX CHARGING RECORD THRU 3/28/52

<u>Date</u>	<u>Tons</u>	<u>MAD</u>	<u>MAD/t</u>
12/14/51	0.549	308	562
	0.274	159	580
1/4/52	0.274	159	580
	0.549	308	562
	1.646	930	565
1/14/52	3.293	1856	563
2/3/52	1.647	930	564
	1.646	942	571
2/6/52	3.293	1854	562
2/7/52	3.293	1858	563
2/8/52	3.293	1858	563
2/11/52	3.293	1813	549
2/12/52	3.293	1816	550
2/13/52	3.293	1806	547
2/14/52	3.293	1805	548
2/15/52	3.293	1962	596
2/19/52	3.293	2048	622
2/20/52	3.293	2048	622
3/7/52	0.548	314	573
	1.098	638	582
	0.549	301	549
	1.098	668	608
3/10 - 12	3.293	1914	581
3/13/52	3.293	1914	581
3/14/52	3.293	1918	582
3/17/52	3.293	1916	581
3/19/52	3.293	1917	582
3/19/52	3.293	2046	621
3/21/52	3.293	2046	621
3/24/52	3.293	2050	623
3/24/52	3.293	2046	621
3/26/52	3.293	2046	621
3/27/52	3.293	1954	593
3/28/52	3.293	1956	594
Total	85.62	50,104	585 (wt. ave.)

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DETAIL B

REDOX INVENTORY ON 3/28/52

<u>Vessel</u>	<u>"Run"</u>	<u>Tons</u>	<u>Estimated(2) M.D/t</u>	<u>M.D(1)</u>
A-2	Chg. + heel (B-12)	5.272	604	3184
B-2	Chg. + heel (B-13?)	5.134	605	3106
D-7	FE-43	1.073	~ 590	633
E-10	"E-12 batch 19"	0.617	581	358
E-11	"E-12 batch 19"	0.039	581	23
E-12	Batch 18	2.507	581	1457
F-1		0.404	~581	235
F-2		0.565	~581	328
F-4		0.378	~581	219
F-5		0.503	~581	292
F-7	EE-13	1.707	594	1014
H-1	EE-14	3.172	607	1925
H-4	EE-15	3.167	607	1922
H-5		0.016	~ 581	9
H-7	D-10 & 11	7.712	622	4797
Columns		0.120	~ 581	70
Total		32.39		19472 → 601 M.D/T wt. ave.

(1) Calculated for each vessel from estimated M.D/t.

(2) M.D/t estimate based on charging record and elapsed time since charging.

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DETAIL C

RECEIPTS BY 224U

<u>Date</u>	<u>Source</u>	<u>Tons U</u>	<u>Remarks</u>
Nov. (?)	321 Bldg. cold feed	3.83	{ Became Lots 001T thru 004T plus hold-up; finished calcining on 1/31/52.
Dec.	Redox cold runs	3.60	
Jan.	Redox cold runs	3.64	{ Became Lots 001 and 002.
Feb.	Redox "5%" runs	9.46	{ Became Lots 003 thru 006; finished calcining 2/14/52.
Feb.	Redox "full level" runs	13.20	{ Became Lots 007 thru 025, when combined with Mar.-Apr. "trailer" below.
Mar. (1)	Redox full level runs	43.11	
subtotal		(76.84)	(Less 3.83 becomes 73.01 rec'd from Redox)
Mar-Apr. "trailer" (E-12 batches 18, 19, 20)(2)		8.64	{ Received into C-1 prior to start of lagging in I-1; some went to Lots prior to 026.
Total for 224U accounting		85.48	

(1) This 43.11 Tons cuts off at 3/28/52

(2) E-12 batch 18 = 2.507 Tons

19 = 2.142 Tons

20 = 3.989 Tons

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DETAIL D

SHIPMENTS FROM 224 U

<u>Lots</u>	<u>Type</u>	<u>Tons U</u>	<u>Pounds 235</u>	<u>Shipped</u>
001T - 004T	normal	5.20	74.0	ca. April
001	"	2.114	30.5	Jan.
002	"	2.143	30.5	Feb.
003 - 006	"5%"	11.077	157.8	Feb.
007 - 009	depleted	8.31	112.5	Mar.
010 - 013	"	11.25	149.0	Mar.
014 - 025	"	<u>33.945</u>	<u>441.9</u>	Apr.
TOTAL		74.07	996.2	

DETAIL E

224 U INVENTORY (at end of campaign)

<u>Item</u>	<u>Tons U</u>
Trailer UO ₃ on lot 025(1)	0.43
C - 1 Tank Inventory (2)	<u>5.53</u>
TOTAL	5.96

(1) Drums 1 and 2 of lot 026 were filled with cleanout material after lot 025 and stored until Mallinckrodt material run.

(2) As of 4/31/52, but nothing added to it after E-12 batch 20, since X-1 filling.

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