

BOOK38R

Notes:

"U-Metal Slabs $\frac{H}{X} \approx 0$ to 5 ^{252}Cf Flux" and "D.W.M." on spine of book

Blank pages: inside front cover sheets, 18-20, 24-30, 38-40, 46-50, 56-60, 68-70, 74-76, 79-83, 89, 90, 94, 95, 100-102, 106-108, 112-114, 116-118, 122-124, 128-130, 135-142, 150-153, 162, 170-174, 178, 184, 190, 195, 198, 201, 202, 206, 210, 213-215, 222, 226, 230, 233, 234, 238, 239, 256-293, 298-300, inside back cover sheets

- page 2 has 3 sheets glued to it
- page 3 has 2 sheets glued to it
- page 4 has 2 small graphs taped to it
- page 5 has 1 graph taped to it
- page 12 has 1 graph taped to it
- page 25 has 2 photos taped to it
- page 36 has 2 photos taped to it
- page 87 has 2 photos tape to it
- page 95 has 1 sheet glued to it
- page 132 has 1 photo taped to it
- page 154 has 1 sheet taped to it
- page 158 has 1 photo taped to it
- page 216 has 1 sheet glued to it
- page 217 has 1 sheet glued to it
- page 242 has 1 graph glued to it
- page 243 has 1 graph glued to it
- page 250 has 1 (8.5x11) sheet glued to it

Scanned by:

Sheila Finch

RSICC /Oak Ridge National Lab.

August 9, 1999

U-Metal
Slabs

$\frac{H}{X}$

0 to 5

252
CF

Flux

D.W.M.

S149

R

300



Account Book

No. S 149

NO UNITS

Journal

Ledger, Single Entry . .

Ledger, Double Entry .

Record Ruled (27 Lines)

Made in 150, and 300 Pages

MADE IN U. S. A.

TO REORDER, SPECIFY NUMBER,
RULING AND THICKNESS INDICATED
ON BACKBONE OF THIS BOOK.

Sizes, weights, and numbers of uranium metal slabs.

	No.	Wt.
7/8x5/10	1000	13,204
	1003	362
	07	361
	13	365
	27	404
	30	382
	39	413
	53	436
	54	396
	55	433
		<u>133 756</u>
	1/2x5/10	0964	7,650
5		<u>7 669</u>
		15 319
1/4x5/10	0986	3,851
	5	<u>30</u>
		7 681
1/8x5x10	0954	<u>1,904</u>
	1031	20
	43	27
	44	20
	49	07
	59	10
	60	28
	63	20
	64	22
	65	<u>39</u>
		19 197
		38 43
		153 54

	No.	Wt.
7/8x3/10	1037	8,032
	38	38
	40	26
	52	<u>52</u>
		32 164
1/2x3x10	0999	4,589
	1006	<u>4,608</u>
		9 197
1/4x3/10	0988	2,301
	89	<u>05</u>
		4 676
1/8x3/10	0994	1,157
	1042	61
	47	60
	76	<u>(45)</u>
		46 23
7/8x2/10	1036	5,344
	50	47
	57	59
	58	<u>51</u>
		21 4 01
1/2x2x10	1004	3,065
	87	<u>73</u>
		6 138
1/4x2x10	0949	1,528
	87	<u>31</u>
		3 059
1/8x2x10	0998	769
	1041	<u>68</u>
	45	75
	47	<u>71</u>
		30 83

$\frac{1}{2} \begin{matrix} 3 \times 10 \\ 2 \times 10 \end{matrix} > = 15 335$
 $\frac{1}{4} \begin{matrix} 3 \times 10 \\ 2 \times 10 \end{matrix} > = 7 665$
 $\frac{1}{8} \begin{matrix} 3 \times 10 \\ 2 \times 10 \end{matrix} > = 7 706$
 Total $> 15 371$

7/8x5x5	1008	6,695	
	10	93	
	11	89	
	12	84	
		<u>26,761</u>	
1/2x5x5	0967	3,838	
	70	22	
	71	27	
	1916	46	
		<u>15333</u>	
1/4x5x5	0950	1,916	
	55	16	
	57	18	
	1915	20	
		<u>7670</u>	
1/8x5x5	1023	963	
	24	963	
	48	961	
	1914	958	
		<u>3845</u>	
3/32x5x5	1912	710	
	21	13	
	50	21	
	51	12	
	52	17	
	1984	715	
	85	15	
	86	16	
	87	11	
	88	16	
	1989	715	
	90	11	
	91	15	
	92	15	
	93	14	
	11430	714	
	95	12	
	96	13	
	97	05	
	98	12	
	1999	714	
	2000	14	
	01	14	
	02	14	
	03	15	

	No.	Wt.
1/16x5x5	1913	477
24		520
unmm		(ea)
2 each		
1/32x5x5		
2 each		
1/32x2.5x2.5		
7/8x2x5	0943	2,680
	44	2,682
	45	2,679
	46	2,682
		<u>10723</u>
1/2x2x5	0974	1,534
	75	33
	76	33
	77	36
		<u>6136</u>
1/4x2x5	0948	765
	58	764
	59	768
	60	768
		<u>3065</u>
1/8x2x5	0995	381
	1033	386
	34	385
	51	384
		<u>1536</u>
7/8x1x5	0942	1,341
	1085	1,346
		<u>2687</u>
1/2x1x5	0978	768
	0979	769
		<u>1537</u>
1/4x1x5	0962	385
	0963	383
		<u>768</u>
1/8x1x5	1015	193
	1032	192
		<u>385</u>
7/8x1x1	0937	269
	0938	268
	0939	268
	0940	268
1/8x1x1	1018	38
	1021	38
	1022	38
	1025	38

these not expected to be
used

2212232

NEGATIVE

2 X 5	4 ea. $\frac{1}{8}$ 7/8
	4 ea. $\frac{1}{4}$ 7/8

5	2 ea. $\frac{1}{8}$ 7/8
	2 ea. $\frac{1}{4}$ 7/8

(X)

7/8

83 pc 0.015 x 5 x 10 polyethylene = 933.3 g
 11.2445 g / per piece

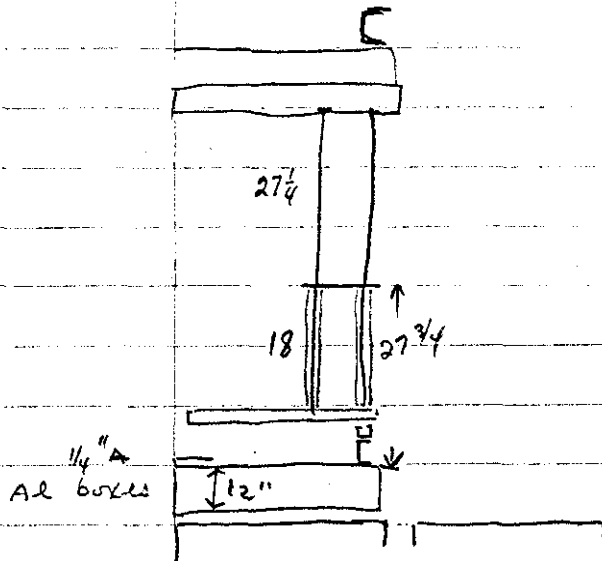
39 pc 0.063 x 5 x 10 polyethylene = 1740.9 g
 44.638₄₆ g / per piece

	10 ea	1/8 x 3/16	
5x10	2 ea	1/4 x 1/2	
	4 ea	1/8 x 3/16	
3x10	2 ea	1/4 x 1/2	
	4 ea	1/8 x 3/16	
2x10	2 ea	1/4 x 1/2	
	4 ea	1/8 x 3/16	2 ea 1/32
5x5	4 ea	1/4 x 1/2	25 ea 1/16
			25 ea 3/32

Uranium pieces available
 for arrays of U + CH₂
 (brought in from venell on 2-6-67
 and unwrapped and stored
 in 113 (South cell)

6

"Tinker Toy" Support Rods on Split Table Apparatus
ORNL-TM-868



February 8, 1967

Aligned supports for 5x10 and 5x10 uranium pieces for 10x10 base area experiments on Split Table apparatus.

Placed 14 x 5 x 10 (Nos. 0986 & 1075) ^{= 7,681 g} on the 1/16 in Al support piece - checked alignment. Scrammed tables - no motion on scram, only when bumps the 54 in position does the metal slide.

~~Change wire in control so that SV-2 starts cycling on Reverse and on Scram when table reaches position "54" microswitch. (Table operation on reverse only now vents SV-2 when this microswitch contact is closed.)~~

Operation time clock reads 3939 hours.

Febr. 9, 1965 Added 3rd Rubber Bumper on Airdraulic Cylinder pushrod so that the bump is eased.

	IC-1	IC-2	IC-3	IC-4	C ₃	C ₄
No Source	.4 x 10 ⁻¹²	.3 x 10 ⁻¹²	< 10 ⁻¹³	< 10 ⁻¹³	↓ (5 Min)	
Source Inserted	.55 x 10 ⁻¹²	1.0 x 10 ⁻¹²	8 x 10 ⁻¹³	3 x 10 ⁻¹³	↓ 120 - 1300	
	[1/8 x 10 x 10]				→ C ₄ (5 Min) C ₃	
	13700 - 140					

Chamber locations

- IC-1 on platform
- 2 below fixed Table
- 3 " " "
- 4 below movable near ^{middle} end of airdraulic cylinder

Instrument Check on Febr 9 Radio

IC-11	Motor Trip	OK	Motor Trip	OK
IC-11 Building Alarms #1 tripped after several attempts 1(NG) 2OK 3OK				
IC-12	3 x 10 ⁻¹² Motor Trip	OK	Motor Trip	OK
IC-20	3 x 10 ⁻¹² Motor Trip	OK		
IC-37	OK	Calibration	Down	
IC-4	OK	Calibration	Down	
CRX	Motor Trip			

Down & CC

1⁰⁰ pm Added EXP =

4ea	3/32 x 5 x 5 (1912-21-50-51)	2856
4ea	1/16 x 5 x 5	1920
4ea	1/2 x 5 x 10 (0964-0965)	15319
4ea	1/8 x 5 x 10 (0954-1031-1043-1044)	7671
4ea	1/16 x 5 x 5	1920

29686

7681

37367

	Together	Apart
IC-1	.02 x 3 x 10 ⁻¹¹	.02 x 3 x 10 ⁻¹¹
2	.05 x 3 x 10 ⁻¹⁰	.4 x 10 ⁻¹¹
3	1.5 x 10 ⁻¹²	1.0 x 10 ⁻¹²
4	1.0 x 10 ⁻¹²	0.8 x 10 ⁻¹²
C ₃	150.	150.
C ₁	15640.	15130.

1.03

EXP

$E \times P = 2$

1⁵⁰ PM Added

2ea	$3 \times 10 \times \frac{1}{2}$	9197	(6999 + 1006)
2ea	$2 \times 10 \times \frac{1}{2}$	6138	(1004 + 1087)
2ea	$3 \times 10 \times \frac{1}{4}$	4606	(0988 + 0989)
2ea	$2 \times 10 \times \frac{1}{4}$	3059	(0949 + 0987)
4ea	$\frac{1}{6} \times 5 \times 5$	1920	

Together 24920

IC-1	$.02 \times 3 \times 10^{-11}$	38367
2	$.055 \times 3 \times 10^{-11}$	62287
3	1.35×10^{-12}	
4	1.15×10^{-12}	

C-1 18910. $1.25 \rightarrow^{0.8}$ Stack measured ~ 2 1/2

3 150. $E \times P = 2$ Non. height 2 1/32

2³⁰ PM Added

4ea	$\frac{1}{2} \times 5 \times 5$	(0967, 70, 71, 1910)	15333
4ea	$\frac{1}{4} \times 5 \times 5$	(0950, 55, 57, 1915)	7672
4ea	$\frac{1}{6} \times 5 \times 5$		1920

IC-1	$.035 \times 3 \times 10^{-11}$	34925
2	$.09 \times 3 \times 10^{-11}$	62287
3	2.2×10^{-12}	87,212
4	2.0×10^{-12}	

C-1 250 \uparrow 538 pc no $\frac{1}{6} \times 5 \times 5$ no. 1913 is not flat, do not use.

C-3 28100 1.86 Multiplication ~ 2 on all inst.!

3⁰⁵ Added

2ea	$\frac{1}{8} \times 5 \times 10$	(1049, 1059)	3817
-----	----------------------------------	--------------	------

EIP 1 IC-1 .055

4ea	$\frac{1}{32} \times 5 \times 5$	1952, 1984 ^{85, 86}	2863
4ea	$\frac{1}{6} \times 5 \times 5$		1920

2	$.15 \times 3 \times 10^{-11}$		
3	3.7×10^{-12}		
4	2.7×10^{-12}		
C-1	44850	$2.96 \rightarrow$ 338	8600
3	420		87212
			<u>95,812</u>

EXP = 5

3⁴⁰ PM Added 2ea $\frac{1}{8} \times 5 \times 10$ (1060, 1063) $\frac{3848}{95812}$
 Together $\frac{99660}{99660}$

IC-1	.09 x 3 x 10 ⁻¹¹		
2	.25 x 3 x 10 ⁻¹¹		
3	6 x 10 ⁻¹²		
4	6 x 10 ⁻¹²		
C-1	68430	4.52 x 221	
C-3	660		

4⁰⁵ Addl EXP 6 7ea $\frac{1}{16} \times 5 \times 5$ - - $\frac{1920}{99660}$
 $\frac{101580}{101580}$

IC-1	.12 x 3 x 10 ⁻¹²	
2	xxxx defective	
3	8 x 10 ⁻¹²	
4	9 x 10 ⁻¹²	
C-1	94180	$\frac{15130}{94180} = .161$
3	840	

Total thickness nominal = 3.3125 = 3 ⁵/₁₆

Feb 10.

Measured size of assembly after straightening stack

Fixed table	MOV.
3.355	3.350
3.360	3.360
3.350	3.350
3.340	3.345
<u>3.351</u>	<u>3.351</u>

Volume = 3.351 x 10 x 10 = 549.128

$\frac{101580}{549.128} = 18.50$ g/cc

Instrument Check on Feb 10, 67 Source Radium

PN-1	2	Low Trip	OK	Hi Alarm Trip	OK
PN-2				Alarm Trip	
IC-1	3×10^{-11}	Meter Trip	OK	Fast Trip	OK
IC-2	3×10^{-11}	Meter Trip	OK		
IC-3	1.3×10^{-10}	Calibration	OK		
IC-4	1.3×10^{-10}	Calibration	OK		
CRM		Meter Trip			

Bldg Alarm #1 did not trip
 #2 OK
 #3 OK

EXP #6

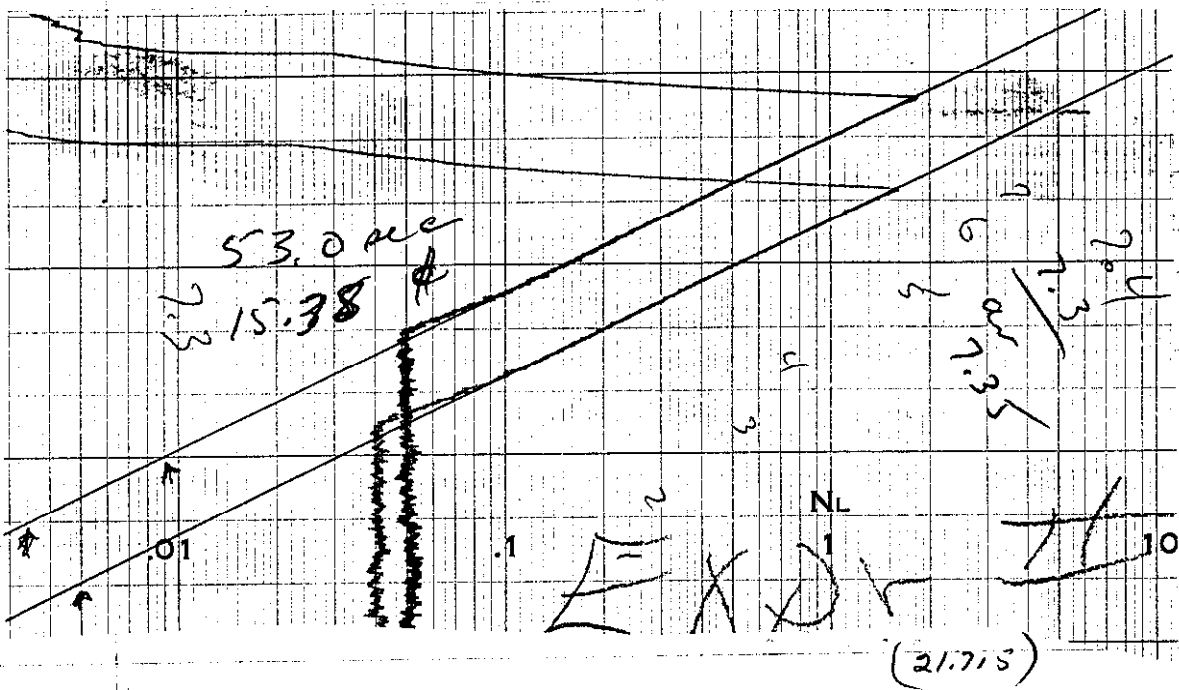
Repeat of last Multi. point

C-1	10049.0	IC-1	$.135 \times 3 \times 10^{-11}$
C-3	960	IC-2	$.37 \times 3 \times 10^{-11}$
		IC-3	9×10^{-12}
		IC-4	1.1×10^{-11}

EXP #7

Add 2ea $1/8 \times 5 \times 10$ (1064, 1065) 3861
 101580
 105441

Approx crit @ 2.8 \rightarrow ≈ 0.13 inches
 tperiod 2.6 est .060/Rev or .012"
 $53.0 \text{ sec} \rightarrow \frac{15.38}{.012} = 1.28 \text{ } \mu\text{/mil}$



EXP = 8

Remove 4 ea. $\frac{1}{16} \times 5 \times 5$

105441
 1920
 103521

Subcritical

- 1
- 2
- 3 3×10^{-4}
- 4 3.4×10^{-11}

EXP = 9

Add 2 ea. $\frac{1}{16} \times 5 \times 5$ to fixed table 960

103528
 104481

Approx Crit 1.9 Rev separation distance
 + Period 1.7 is small

$10.3 \text{ div} / 2 \text{ Rev} \left(\frac{.5}{10} = .050 \text{ in/Rev} \right)$

$\frac{10.3 \rightarrow 74.5 \text{ sec} \rightarrow 12.07}{.010 \quad \quad \quad .01} = 1.21 \text{ } \phi / \text{in}$

EXP #10

Remove 2 ea $\frac{1}{16} \times 5 \times 5$ Fixed tableAdd 2 ea $\frac{1}{32} \times 5 \times 5$

Straightened stack?

$$\begin{array}{r} 750 \\ 103521 \\ \hline 104.001 \text{ kg} \end{array}$$

Subcritical negative period

$$\approx 4.38 \text{ dia/decade} = \approx -95 \text{ sec} = 2.12 \times 10^{-4}$$

$$= -33 \text{ } \phi \text{ approx. } \text{Looked at gap less than } 10 \text{ mil}$$

EXP #11

Add $\frac{1}{16}$ alum $10 \frac{7}{8} \times 4$ on movable stack
(straightened stack) $+1053 \text{ sec} \rightarrow$
1.2 ϕ

Supercritical just a few cents at contact
Alignment is quite good - a bit better than
#10.

EXP #12

Repeat #11

Supercritical +869 sec 1.4 ϕ

EXP #13

Added $\frac{1}{16} \times 5 \times 5$ aluminum piece on fixed
table.

Supercritical +41.9 sec = 18.0 ϕ

$$\text{Alum length} = 18.0 - 1.3 = 16.7 \text{ } \phi$$

EXP #14

Remove $\frac{1}{16} \times 5 \times 5$ Add $\frac{1}{16} \times 4 \times 5$ Supercrit. + 54.3 pec 15.13 ϕ $\frac{1}{16} \times 4 \times 5$ al worth $(15.1 - 1.3) = 13.8 \phi$ Set IC-2 meter ~~at~~ beam point @ 50%.

(Recorder marked 62%)

Stack shifted less than $\frac{1}{8}$ in ~~or~~ on
separation ~~at~~ alignment must be
checked!

Bare Uranium system

 $3\frac{7}{16} \times 5 \times 10$ $3\frac{15}{32} \times 5 \times 10$ would be sub-critical by $+1.3 - 6(13.8) = -81.5 \phi$ Actual
for final sizeExp #10 was therefore subcritical by only -26.3 ϕ

based on al calc. (instead of req period mea of -33)

Instrument Check on Feb 13, 1967 Source Radium 10mc Source

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	10×10^{-12} Scaler Meter Trip	OK	Fast Trip	OK
IC-2	10×10^{-12} Scaler Meter Trip	OK		
IC-3	1.4×10^{-12} Calibration	Done		
IC-4	1.4×10^{-12} Calibration	Done		Draft Gauge Cell Press
CRM	Meter Trip			- 0.8 in H ₂ O

Bldg Alarm #1 did not trip #2 OK #3 OK

Exp #15

Straightened mouse hole. Repeat #14 Temp near table 21.6 - 8°C

System has gained reactivity + period quite short less than 20 sec table at v.1.7 Rev (specimen believed to be in contact).

Exp #16

Remove $\frac{1}{16} \times 4$ alum on Fix table (-13.8¢)
+ 11.0¢ (84.06 sec)

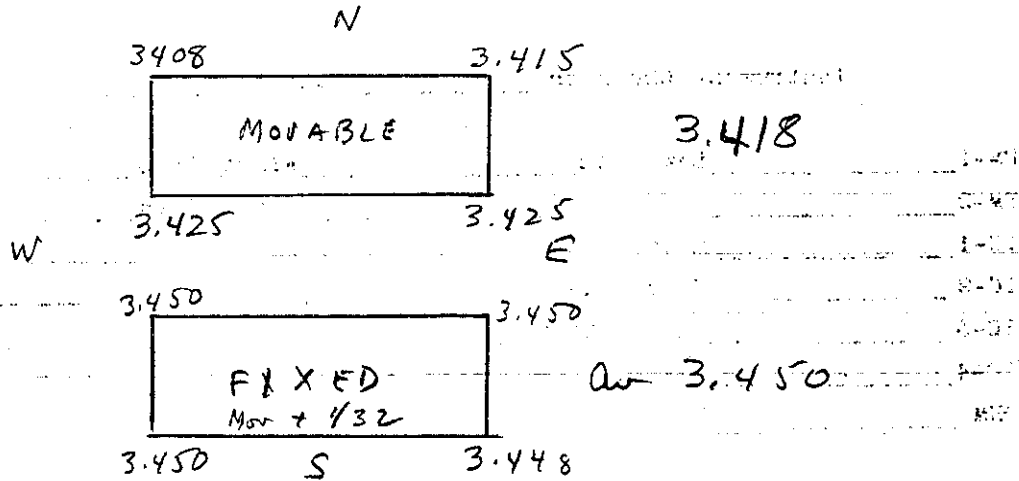
Exp #17

Remove $\frac{1}{32} \times 5 \times 5$ Fuel Add $5 \times 5 \times \frac{1}{16}$ Al (16.7¢)
+ 6.25 div 21.72 = +135.8 = +7.56¢
worth of fuel $\frac{1}{32} \times 5 \times 5 = +11.0 - (7.6 - 16.7)$
= 20.1¢

Bare critical system would therefore be

$$\frac{81.5}{20.1} = 4.0 \text{ pieces of } \frac{1}{32} \times 5 \times 5$$

$$104.001 + 960 = 104.960 \text{ kg U}$$



Average height 3.434

Increase height .032 for alarm.

Equiv barsystem 3.466 x 10 x 10 inches
 $8.804 \times 25.4 \times 25.4 = 56.8008 =$

$\lambda = 2.1 \text{ cm}$
 0.0614

$B^2 \cdot 0.05837 + 0.01127 + 0.01127 = 8.091 \times 10^{-8} @ \rho = 18.479 \text{ g/cm}^3$

$B = 1.28445 \quad \tilde{R} = 11.04$

$R = 8.89 \quad R^2 = 781.63$

$Vol = 3,274.09$

$\times 18.479 \quad 60.50 \text{ kgU}$

Check Uranium layers to be as follows;

Movable Fixed

$\frac{1}{32}$	$\frac{1}{8}$	$\frac{1}{32}$	$\frac{5}{32}$
	$\frac{1}{8}$	$\frac{1}{8}$	
	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{13}{32}$
		$\frac{2}{32}$	
		$\frac{1}{8}$	
		$\frac{1}{16}$	$\frac{13}{16}$
		$\frac{1}{4}$	$\frac{14}{16}$
		$\frac{1}{2}$	
		$\frac{1}{16}$	$\frac{13}{16}$
		$\frac{1}{4}$	$\frac{10}{16}$
		$\frac{1}{2}$	
		$\frac{1}{16}$	
		$\frac{1}{8}$	$\frac{13}{16}$
		$\frac{1}{8}$	
		$\frac{1}{2}$	
		$\frac{1}{16}$	$\frac{13}{32}$
		$\frac{3}{32}$	$\frac{32}{32}$
		$\frac{1}{4}$	

$$\frac{52}{16} = 3.25$$

$$.125$$

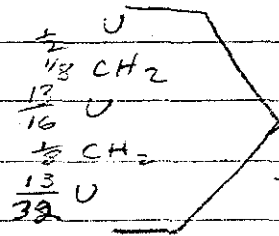
$$3.375$$

$$15$$

$$\begin{array}{r} 3.25 \\ .125 \\ \hline 3.375 \\ .016 \\ \hline 3.391 \end{array}$$

1-3
-20

1



Exp # 18

No apparent multiplication

$$\frac{23}{32} \cdot 1.72 = 3.25$$

$$3.25 \cdot 16.60 = 53.8$$

~53.8 kg

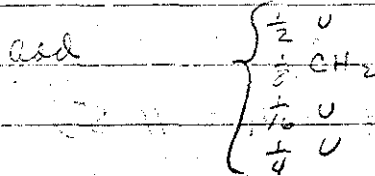
IC-1	→ .03 x 3 x 10 ⁻¹¹
2	.05 x 3 x 10 ⁻¹¹
3	1.2 x 10 ⁻¹²
4	1.2 x 10 ⁻¹²
C-1	17800
3	170

(3.25 stack will be identical to

Exp # 5 + 1/2 CH₂) apart
99,660 g

C-1	17800	$\frac{15300}{17800} = .86$
3	170	
C-1	16620	$\frac{16620}{17800} = .93$
3		

Exp # 19



TOTAL U = 2 2/32 = 2.531325 = 2.7788

= 77.62 kg Sub Crit

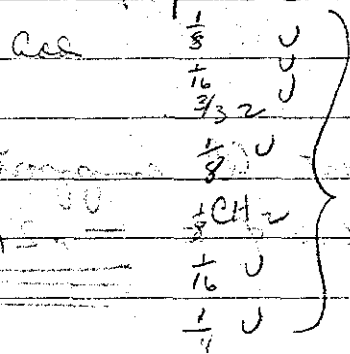
$$\frac{15300}{23980} = .638$$

$$\frac{16620}{23980} = .693$$

IC-1	.03 x 3 x 10 ⁻¹¹
2	.065 x 3 x 10 ⁻¹¹
3	1.8 x 10 ⁻¹²
4	1.8 x 10 ⁻¹²
C-1	23980
3	210

apart C-1 20120
110

Exp # 20



3.25 U

0.500 CH₂

Tables @ 2.0 Rev

+ period

Super critical

Exp # 21

Remove ²⁰⁰ 1/16 x 5 x 5 Add ²⁰⁰ 1/32 x 5 x 5 on fixed table

-143A -12.9 g subcritical

Exp # 22

Remove $\frac{1}{16}$ all $\frac{1}{16}$ 5x5

$$+ 7.75 \text{ div/dec} \rightarrow 168.3 \rightarrow 6.3 \phi$$

Reduce $\frac{1}{16}$ by sig. table $\sim 6.0 \text{ Rev} \rightarrow$

$$+ 7.60 \text{ div/dec} \rightarrow 165.1 \rightarrow 6.4 \text{ or } 1.667 \rightarrow 6.37 \phi = 6.4$$

4 on $\log N = 320$ on Bldg Alern No ^{#3}

Exp # 23

Added $\frac{1}{16} \times 4 \times 5^+$ all

$$+ 1.94 \text{ div/dec} \rightarrow 42.1 \text{ sec} \rightarrow 17.9 \phi$$

all with $(17.9 - 6.4 = 11.5)$

Exp # 24 same as Exp # 20 99.660 kg

Remove $\frac{1}{16} \times 4 \times 5^+$ all

$$\frac{1}{32} \times 5 \times 5 \text{ U}$$

Add $\frac{1}{16} \times 5 \times 5 \text{ U}$ — Now 3.25 on each half.

$$+ 1.175 \frac{\text{div}}{\text{dec}} \rightarrow 25.5 \text{ sec} \rightarrow 24.4 \phi$$

 \therefore Bare system without all support plates

$$24.4 - 46.0 \phi = \underline{\underline{-21.6 \phi}}$$

$$\text{worth of } \frac{1}{32} \times 5 \times 5 = 24.4 - 6.4 = 18.0 \phi$$

Measured thickness 2-13

Total Plastic

Fixed	Movable	
3.750 58	3.766	60
3.762 50	3.754	53
3.756 50	3.754	70
3.754 57	3.770	62
<u>3.754</u>	<u>3.770</u>	61
	244	
3.756 ⁵⁴	3.761	
<u>3.761</u>		
<u>116</u>		

~~16 x 44.638~~
~~= 714.22 g~~
 $\frac{H}{x} = \frac{714.22}{17.026} = 41.934$
~~235.05~~
~~99.660~~
~~x 9.34~~
~~93.08~~
~~1305.26~~
~~= 0.1286~~

3.758 Average height Vol = 6,158.2 cm³
 9.545 cm

$\frac{99.660}{6.158} = 16.183$

$\lambda = 2.1 \text{ cm}$ $B = .22856^2 +$

$\frac{.105224}{.2254} = .467$
 $\frac{.07478}{.2254} = .332$

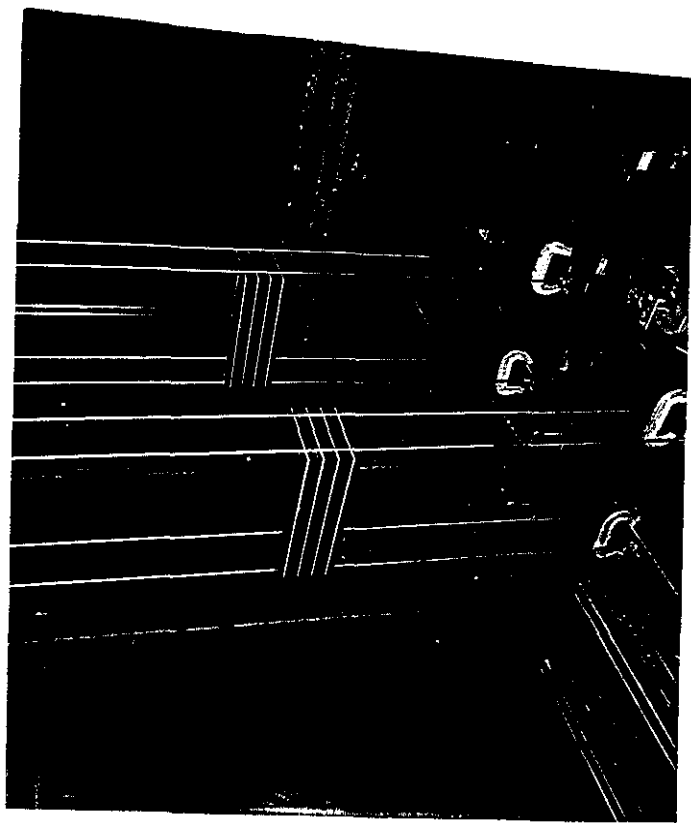
$\tilde{B} = .2735$

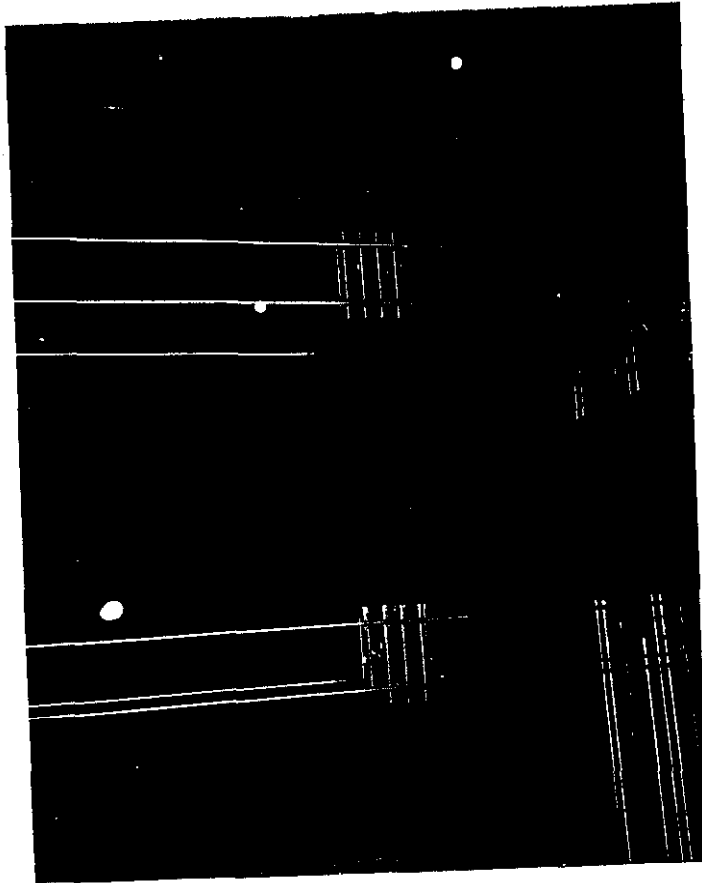
$\tilde{R} = \frac{11.49}{2.15} \text{ cm}$

Vol = 3412.95

$R = 9.34 \quad R^3 = 81478$

$\times 16.183 = 55.234 \text{ kg U sphere}$





Instrument Check on Febr 14 Source 10mcX

PM-1	Low Trip	OK	Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	Meter Trip	OK	Fast Trip	OK
IC-2	Meter Trip	OK		
IC-3	1.7×10^{-11}	Calibration OK		
IC-4	1.4×10^{-11}	Calibration OK		
CRM	Meter Trip			

Bldg Alarm "A" flickered but would not trip on
 "B" OK
 "C" OK

C-1 19740
 C-3 160

Tables

Restocked assembly

2 ea	$\frac{1}{4} \times 5 \times 10$	(0986, 1075)	7681
8 ea	$\frac{1}{16} \times 5 \times 5$		3840
10 ea	$\frac{1}{16} \times 5 \times 10$	CH ₂	
2 ea	$\frac{1}{2} \times 5 \times 10$	(0964, 0965)	15319
4 ea	$\frac{1}{8} \times 5 \times 10$	(0454, 1031)	9671
10 ea	$\frac{1}{16} \times 5 \times 3 \times 10$	CH ₂ (1043, 1044)	
2 ea	$\frac{1}{2} \times$		9197
2 ea	$\frac{1}{2} \times 2 \times 10$		6138
2 ea	$\frac{1}{4} \times 3 \times 10$		4606
2 ea	$\frac{1}{4} \times 2 \times 10$		3059
10 ea	$\frac{1}{16} \times 5 \times 10$	CH ₂	
4 ea	$\frac{1}{2} \times 5 \times 5$	(0967-7074, 1916)	15333
			72644

EXP #25 — Submit.

IC-1	
2	$.1 \times 3 \times 10^{-11}$
3	1.4×10^{-12}
4	1.9×10^{-12}

C-1 24710 .799
 210

$\frac{1}{M}$

EXP #26 - Supercrit

All 4 ea $\frac{1}{16} \times 5 \times 5$ ~~7670~~ 767210 ea $\frac{1}{16} \times 5 \times 10$ CH₂4 ea $\frac{1}{8} \times 5 \times 10$ 1049-59-60-63 76658 ea $\frac{1}{16} \times 5 \times 5$ 3840

Table section ~ 4.0 Rev ~ crit

18977

72844

91821

Exp #27 - Supercrit.

Remove ^{2 ea} $\frac{1}{16} \times 5 \times 10$ (Fixed Table) 760

Table per ~ 3.3 Rev ~ crit

91061

Exp #28

Remove 4 ea $\frac{1}{16} \times 5 \times 5$ (Mov. Table) 1920Critical layer per > 1000 sec. 89,141

Estimate that fuel on outside worth $\frac{1}{3}$ - $\frac{1}{4}$ the value of disk fuel, therefore from plot of Crit mass vs. CH₂ thickness, it is estimated that one should use 4 ea $\frac{1}{16}$ + 3 ea .015 for the plastic layer thickness.

Exp #29

Restacked assembly with 4 ea $\frac{1}{16} \times 5 \times 10$ in each layer ^{CH₂}
 + 3 ea .015 x 5 x 10 in each layer

Supercritical + per ~ 3.3 Rev (~ 0.15 in)
 level ~ 3.5 Rev

Exp #30

Restacked assembly with 4 ea $\frac{1}{16} \times 5 \times 10$ in each layer ^{CH₂}
 92.021 kg U

Subcritical! and dead

Exp #31

Restacked with 4 ea $\frac{1}{16} \times 5 \times 10$ CH₂

1 ea .015 x 5 x 10 CH₂

Subcritical - period ~ 75 sec

Exp #32 - 707 + 10.10 = 587 9

Restacked with 4 ea $\frac{1}{16} \times 5 \times 10$ CH₂

1 ea .015 x 5 x 10 CH₂

Supercritical \sim crit ~ 2.3 Rev

Exp #33

Removed $\frac{1}{16} \times 5 \times 10$ (FIXED TABLE)

+ Period 5.1 ϕ

Exp #34 (Repeat #34)

+ Period 5.0 ϕ

EXP #35 Add $\frac{1}{16} \times 4 \times 5^+ \text{ al}$
 + Period 14.7¢

EXP #36

Remove $\frac{1}{16} \times 5 \times 5 \text{ U}^L$ (Mtr)
 Add $\frac{1}{32} \times 5 \times 5 \text{ U}$ (Fixed)
 Add $\frac{1}{16} \times 4 \times 5^+ \text{ al}$ (Mtr)
 + Period 9.5¢

Worth of $\frac{1}{16} \times 4 \times 5^+ \text{ al} = 14.7 - 5.05 = 9.65¢$

Worth of ~~Remove~~ $\frac{1}{32} \times 5 \times 5 \text{ U} = \frac{(14.7 + 9.65 - 9.5)}{2} = +14.85¢$

$$\frac{1}{16} \times 5 \times 5 \text{ U} = 59.4$$

React of #32 = $59.4 + 5.05 = 64.45$

Reactivity of #32 bars with ^{mt} alum =
 $64.45 - 38.6 = 25.85¢$

React of #32, starting with react of #36

$$9.5 + 5 \times 14.85 - 2 \times 9.65 = 183.75 - 19.3 = 64.45$$

$$= 32 \text{ bars} - 4 \times 4 \text{ bars} = 38.6$$

$$25.85$$

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	3×10^{-11}	Meter Trip	OK	Fast Trip	OK
IC-2	5×10^{-11}	Meter Trip	OK	32 day alarm	
IC-3	1.2×10^{-10}	Calibration		A	Trips 6 h
IC-4	1.3×10^{-10}	Calibration		B	OK
CRM	Meter Trip	Cell pres -7 in	C	OK	
	Temp	23.3°C	H ₂ O		$\frac{290}{1200}$

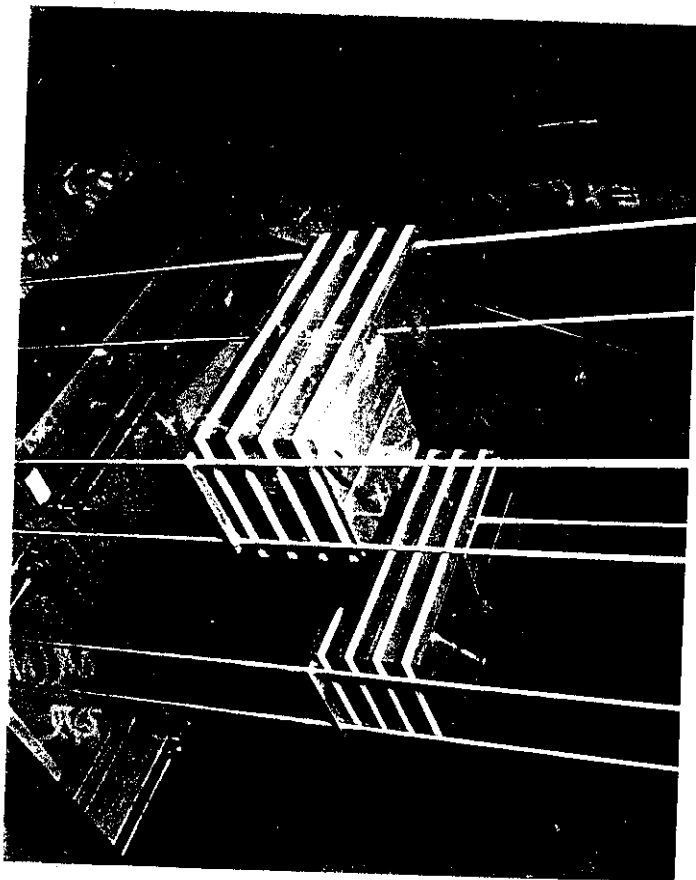
EXP #37 (Repeat = 36) 92021
 + Period $2 \text{ ea } \frac{1}{16} \times 4 \times 5^+ \text{ AR}$ less 1200
90821
 +10.97 Sum. ass. less $\frac{1}{16} \times 5 \times 10$
 $\frac{1}{32} \times 5 \times 5$

EXP #38 (Repeat #33) 12021
 + (Assembly #32 less $\frac{1}{16} \times 5 \times 10$) 960
11061
 + Period 8.09

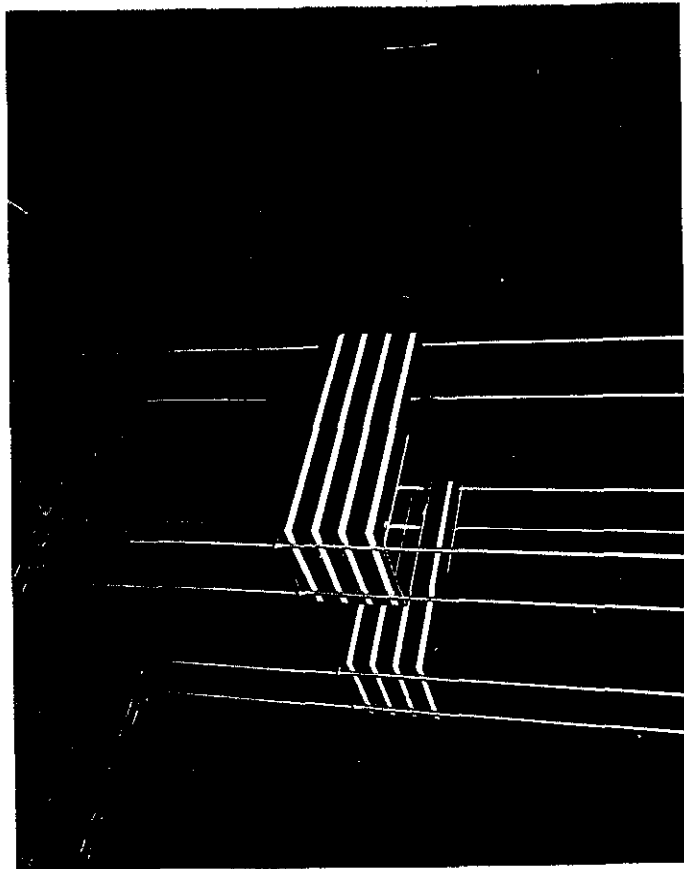
EXP #39 (Repeat = 35) 94021
 Add $\frac{1}{16} \times 4 \times 5^+ \text{ AR} \rightarrow 0.26$
 14.35

EXP #40
 Remove $\frac{1}{16} \times 5 \times 5 \text{ V (Mov.)}$ 91061
 Add $\frac{1}{16} \times 4 \times 5^+ \text{ AR}$ 480
 - Period -5.45 90581

EXP #41
 Add $\frac{1}{16} \times 4 \times 5^+ \text{ AR}$
 + Period 3.34
 $\frac{1}{16} \times 4 \times 5 \rightarrow 8.79$



36



$$.934 \times 14.026 = 13.100_3$$
$$\frac{235.25}{.017942} \times \frac{\text{at } \#1}{\text{well}}$$

Measured size of symmetrical system (Exp #32)

Fixed Movable

4.030	4.045
.025	4.034
.015	4.034
.025	4.033
16.095	16.144

$$B_3^2 = .21762^2 = .04736$$

$$2254$$

$$.06990$$

$$\bar{B} = .2684$$

$$R = 11.88$$

$$2.15$$

$$9.75 \rightarrow \text{vd} = 3.8586$$

$$U = 92.021$$

$$\text{vd} = 7.0382$$

$$= 13,075 \text{ gm}^3/\text{cm}^3$$

$$164.015$$

$$32 \times \frac{1}{16}$$

$$179.9$$

$$1428.4$$

$$1608.3$$

$$\frac{H}{X} = .3136$$

$$\frac{32,239}{8} = 4.030 \rightarrow 10.23 \text{ cm}$$

$$\frac{4.2}{}$$

Worth of $\frac{1}{16} \times 4 \times 5 + \text{al}$

$$\# 35 - \# \left[\frac{33+34}{2} \right]$$

$$14.7 - 5.05 = 9.65$$

$$\# 41 - 40$$

$$3.34 + 5.45 = 8.79$$

$$\# 39 - 38$$

$$14.35 - \frac{8.09}{2} = 6.26$$

$$\frac{29.70}{3} = 8.23$$

$$3.8586 \times 13.075$$

sphere $\rho_0^U = 50.451$
wt.

Worth of $\frac{1}{16} \times 5 \times 5$ fuel

$$14.35 + 5.45 + \frac{8.79}{2} = 28.54$$

Worth of $\frac{1}{32} \times 5 \times 5$ fuel

$$\# 35 - \# 36 + \frac{8.79}{2}$$

$$14.7 - 9.5 + \frac{9.65}{2} = 14.85$$

$$\frac{29.3}{2} = 14.65$$

React of Conf #32 symm and Bare

$$8.1 (\#38) + 54.8 - 32.8 = +30.14$$

$$5.0 (\#34) + 54.8 - 32.8 = +27.0 \phi$$

Above meas does not agree with vol corr, assume
 $4.030 + 0.075 = 4.105$
 meas should be 4.105 similar to 8 layers expect this H/x
 where measured to be 4.104 with same plastic

$EIP = 42$

Uranium metal 3.125 in diam

- ✓ 2ea $\frac{1}{4} \times 5 \times 10$
- ✓ 4ea $\frac{1}{16} \times 5 \times 5$
- ✓ 2ea $\frac{1}{2} \times 5 \times 10$
- ✓ 2ea $\frac{1}{8} \times 5 \times 10$
- ✓ 4ea $\frac{1}{4} \times 5 \times 5$
- ✓ 6ea $\frac{1}{8} \times 5 \times 10$
- ✓ 2ea $\frac{1}{2} \times 3 \times 10$
- ✓ 2ea $\frac{1}{2} \times 2 \times 10$
- ✓ 2ea $\frac{1}{8} \times 3 \times 10$
- ✓ 2ea $\frac{1}{8} \times 3 \times 10$
- ✓ 4ea $\frac{1}{2} \times 5 \times 5$
- ✓ 1ea $\frac{1}{8} \times 5 \times 10$
- ✓ 1ea $\frac{1}{8} \times 3 \times 10$
- ✓ 2ea $\frac{1}{4} \times 3 \times 10$
- ✓ 2ea $\frac{1}{4} \times 2 \times 10$
- ✓ 4ea $\frac{1}{16} \times 5 \times 5$

2ea CH₂ $\frac{1}{16} \times 5 \times 10$

2ea CH₂ $\frac{1}{16} \times 5 \times 10$

2ea CH₂ $\frac{1}{16} \times 5 \times 10$

2ea CH₂ $\frac{1}{16} \times 5 \times 10$

2ea CH₂ $\frac{1}{16} \times 5 \times 10$

480

2ea	$\frac{1}{4} \times 5 \times 10$	7681
8ea	$\frac{1}{16} \times 5 \times 5$	3840
2ea	$\frac{1}{2} \times 5 \times 10$	15319
9ea	$\frac{1}{8} \times 5 \times 10$	17293
4ea	$\frac{1}{4} \times 5 \times 5$	7670
2ea	$\frac{1}{2} \times 3 \times 10$	9197
2ea	$\frac{1}{2} \times 2 \times 10$	6138
3ea	$\frac{1}{8} \times 3 \times 10$	3478
	$\frac{1}{8} \times 2 \times 10$	2315
4ea	$\frac{1}{4} \times 5 \times 5$	15333
2ea	$\frac{1}{4} \times 3 \times 10$	4606
	$\frac{1}{4} \times 2 \times 10$	3059

95929 2 U metal

EXP #42 cont

Subcritical low multiplication

EXP #43

Add $\frac{1}{32} \times 5 \times 10$ U Metal } Fixed Table
 $\frac{1}{16} \times 4 \times 10^+$ Al

Subcritical - with source

Ic - 3 $\rightarrow 8.0 \times 10^{-11}$ and still rising4 8.0×10^{-11} " " R_i Pull source Neg Period ~ 100 seconds

EXP #44

959279^TRestaked $3\frac{1}{8}$ " 5 layer systemwith 2ea $\frac{1}{16}$ & 2ea 0.15 Ctr

in each layer

Subcritical

EXP #45

Add 4ea $\frac{1}{16} \times 5 \times 5$

1920

Supercrit \sim crit @ 3.4 Rev ~ 160 in

PM-1	Low Trip	OK	Hi Trip	OK
PM-2			Alarm Trip	
EC-1	Meter Trip	OK	Fast Trip	OK
EC-2	Meter Trip	OK		
EC-3	1.8×10^{10}	Calibration	Dw ²	Bldg alarm
EC-4	1.5×10^{10}	Calibration	Dw ²	A OK
EC-5		Meter Trip		B OK
				C OK

EXP #46

(Remove 2 ea $\frac{1}{16} \times 5 \times 5$)
 Sum 95 929
 +200 480
 96 409

Sign @ 2.3 Rev

EXP #47

(Remove 2 ea $\frac{1}{16} \times 5 \times 5$)
 Sum 95 929

add 2 ea $\frac{1}{16} \times 5 \times 5$

480
 96 409

+ Period 13.55 ϕ

Drive tables apart to 20 Rev - together

+ Period Same as above

stack looks to be set as straight as usual

EXP #48 straighten stack at 10 Rev

1.1 Report #47 10.00 ϕ - lost 3 ϕ

longer period, gap looks larger!

Restacked and straightened (Fix & Mov)

EXP #49

Temp = 23.8°C

gained reactivity! Very good

+ period 28.22 ϕ

gained stack
 18 ϕ

EXP #50 Remove 2 $\frac{1}{16} \times 5 \times 5$

95.929

+ period 11.95

480

16.27 ϕ

EXP = 51 Remove $32.5 \times 5 \text{ U}$

Stack w/o Source

- Period (hold power in core for 9 min) ^{750 sec}
 - 2.26 before removing source

Fuel removal $- 14.21$

EXP = 52 Add $\frac{1}{2} \times 4 \times 5 = 10 \text{ Al}$

+ Period 8.44

Al worth 10.70 ϕ

Average fuel worth = 14.21

16.27

15.24 ϕ per $\frac{1}{32}$

Al worth $4 \times 10.7 = 42.8 \phi$

React of Bare system w.o. Al supports
 $- 2.26 - 42.8 = -45.1 \phi$

20 cc $\frac{1}{16} \text{ Al}$

892.8

20 cc 0.015 CH

224.9

1117.7 g CH₂

95929

= .010688

Measurements on asymmetrical eye # 51

Fixed - Movable

3,893 -7 3,892 -8

.896 -4 901 +1

.902 +2 903 +3

.894 -6 896 -4

-15

-8

or -3

or 3.897

$$6 \text{ layers } \frac{1}{2} = 3.00 \text{ U Metal}$$

$$\text{Estimated } \text{CH}_2 \text{ } 1 \text{ ea } 2625 + 3 \text{ ea } .015 = 0.1075$$

Uranium inventory

✓ 2 ea	$\frac{1}{4} \times 5 \times 10$	7681
✓ 2 ea	$\frac{1}{2} \times 5 \times 10$	15319
✓ 9 ea	$\frac{1}{8} \times 5 \times 10$	17293
✓ 3 ea	$\frac{1}{8} \times 3 \times 10$	3478
✓ 3 ea	$\frac{1}{8} \times 2 \times 10$	2315
✓ 2 ea	$\frac{1}{2} \times 3 \times 10$	9197
✓ 2 ea	$\frac{1}{2} \times 2 \times 10$	6138
✓ 4 ea	$\frac{1}{2} \times 5 \times 5$	15333
✓ 2 ea	$\frac{1}{4} \times 3 \times 10$	4606
✓ 2 ea	$\frac{1}{4} \times 2 \times 10$	3059
✓ 4 ea	$\frac{1}{4} \times 5 \times 5$	<u>7670</u>
		92089

$$\text{EXP \# 53 } \text{CH}_2 \text{ } 1 \text{ ea } \frac{1}{16} + 3 \text{ ea } 0.015$$

Subcrit (error in estimate) plastic
Restack with 3 ea $\frac{1}{16} \text{CH}_2$

$$\text{Total } \text{CH}_2 = 3 \times 6 \times 2 = 36 \cdot \times 44,6385 = 1607.0$$

$$\text{EXP \# 54 } \cdot \text{CH}_2 \text{ } 1607.0 \text{ U} = 92089 \text{ (6 layers)}$$

Pos Per 1.4 Rev

level ≈ 2.1

Measurements

	4.100	10	4.092	2
N	4.095	5	4.092	5
	4.095	5	4.090	
	<u>4.100</u>	10	4.092	2
		30		6

> 4.095

$$\frac{36}{8} = 4.5$$

Restacked upper 3 layers

Total Plastic now $12 \times 3 \times 2 \times 11.24 \times 5 (0.015) = 809.6$

$3 \times 3 \times 2 \times 49.638 (1/16) = 803.5$

Exp = 55

1613.1

+ Perical 1.6 Rev

level 2.25 Rev

Exp Restacked top 3 layers of plastic

$3 \times 11 \times 2 = 66 \times 11.24 \times 5 = 742.1$

Subcritical

803.5

- 247.6 ϕ \rightarrow - 6.15 ϕ

1545.6

Straighten Stack

Added $\frac{1}{16} \times 4'' \times 5''$ al

Instrument Check on Feb 17 Source 10 mc Gamma (Radium) 53

PM-1	Low Trip	OK	Hi Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	10×10^{-11}	Meter Trip	OK	Fast Trip	OK
IC-2	10×10^{-11}	Meter Trip	OK	Bldg Alarm A	OK (Flickers)
IC-3	1.5×10^{-10}	Calibration	OK	B	OK
IC-4	1.7×10^{-10}	Calibration	OK	C	OK
CRM		Meter Trip			

8:10 AM

EXP = 57 (~~199.8~~) w. $\frac{1}{16} \times 4 \times 5^+$
 + Period

2.33 ϕ

Gap very small

EXP #58 w. $\frac{1}{16} \times 4 \times 5^+$
 + Period

12.02 ϕ

Removal add $\frac{1}{32} \times 5 \times 5$

EXP #59 no alarm
 + Per 121.1 + $\frac{1}{32} \times 5 \times 5$ U (Fixed)

78.3

EXP #60 (Repeat #56) Remove $\frac{1}{32} \times 5 \times 5$

- Per 199.8 - $3 \times 12 \times 2 \times 11.2445$ 809.6

- 8.03 ϕ $3 \times 3 \times 2 \times 44.63$ 803.5

T = 23.8°C

with $\frac{1}{16} \times 4 \times 5 = 9.69$

South	North
4.063	4.077
57	86
62	83
60	77
<u>40605</u>	<u>4.0795</u>

$U \frac{1}{32} \times 5 \times 5 = 9.69 + 5.97 = 15.66$

$U \frac{1}{32} \times 5 \times 5 = 16.33$

5 layers CH_2 $3 \times 10 \times 2$
 1 layer H_2 $1 \times 10 \times 0.15 \times 2$
 Top fuel layer $7 \text{ea } \frac{1}{8} \times 5 \times 5 \rightarrow 3245$
 $7 \text{ea } \frac{3}{32} \times 5 \times 5$
 (Remove $2 \text{ea } \frac{1}{4} \times 3 \times 10$) $\rightarrow 7665$
 $2 \text{ea } \frac{1}{4} \times 2 \times 10$

Subcritical

Restacked Top layer
 3×10 0989 2305
 $7 \times 2 \times 10$ 0149 1528
 Fix $2 \text{ea } \frac{1}{8} \times 5 \times 5$ 1024-1023 963
 $2 \text{ea } \frac{3}{32}$ 1912-1921 710
 713
 24×11 269.9
 $30 \times 44.638 = 1339.1$
 $1609.0 \text{ g } CH_2$
 V 84 424
 3 833
 1924
 1424

 91,607. Total V

EXP #61

∞ period Critical level

EXP #62 $2 \text{ea } \frac{1}{4} \times 5 \times 5 \text{ } V$
 $+ 50.8 \rightarrow 15.84$
 Fuel worth

EXP #63 Remove $\frac{1}{32} \times 5 \times 5 \text{ } V$
 Add $\frac{1}{4} \times 5 \times 5 \text{ } V$
 $+ 100.6 \rightarrow 9.60 \phi$
 Al worth

Measurements on asymmetric array

South	North
4 073	4.100
64	1.04
63	0.91
70	0.93
<hr/>	<hr/>
16.270	16.388

$$\frac{32.658}{8} = 4.082 \text{ Av.}$$

$$4.0675 - 4.0970$$

use $1/32 \times 5 \times 10$ fuel

Symmetrical array 3.00 Fuel use 4

$$2 \times 15.84 = 31.7 \text{ } \phi \text{ Super}$$

Bare Symmetrical array

$$38.4$$

$$31.7 - 4 \times 9.6 = -6.7 \text{ } \phi$$

2-17-67 U-Metal 3.00 x 8 layers (Adjusted tensions for stacking)
 CH₂ 2 ea 1/16 1 ea 015

	5x10	3x10 2x10	5x5		
3/16			3/32 + 3/32	1412	52
3/8		1/8 + 1/8	1/8	21	84
3/8 - 1/8			1/4	50	85
3/8 + 1/8		1/2		51	86
3/8	1/8 + 1/8 + 1/8				
3/8 - 1/8		1/4			
3/8 + 1/8	1/2				
3/8	1/4 + 1/8				
3/16	1/8		1/16		

2 ea 1/2	2 ea 1/2 { 3	1 ea 1/4	15 319
			7 681
2 ea 1/4	2 ea 1/4 { 3	4 ea 1/8	19 197
			9 197
10 ea 1/8	4 ea 1/8 { 2	4 ea 1/16	46 06
			46 23
		8 ea 3/32	61 38
			3 059
			3 083
			7 670
			3 845
			19 20
			57 19

125
15
140

EXP #64

Tails together - gap visible

92 055

Subcritical

- 347.5 sec
 - 4.13¢

16 ea x 11.2445 = 179.9
 32 ea x 44.6385 = 1428.4
 1608.3

a small gap visible - stack straightened.

Instrument Check on 2-21-67 Source 10 mc γ (Radium)

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	10×10^{-11}	Meter Trip	OK	Fast Trip	OK
IC-2	10×10^{-11}	Meter Trip	OK		Bldg Alarm
IC-3	1.3×10^{-11}	Calibration			A - No Trip - (Relay letter)
IC-4	1.5×10^{-11}	Calibration			B - OK
CRM		Meter Trip			C - OK

2-17-67 8⁴⁰ AM

EXP #64 (Repeat #4).

T = 22.5°C

Subcritical - V shaped gap, together at bottom small gap at top.

Found alignment of each half not level may have to unstack and align bottom plate with table together.

EXP #66 check alignment with remote approach to critical.

Just Critical gain of 4.134 over #64 on Friday. There is still a small gap near top of assembly.

Unstacked assembly to

$\frac{1}{2}$ " layer
$\frac{3}{8}$
$\frac{3}{16}$

 metal no longer

in alignment.

Adjusted tension and alignment. Should be as perfect as previously

EXP # 67

Gap at bottom, stack touches at top ~~the~~
when tables together, separate table

Checked alignment - when tables apart
and it was no longer level in the N-S
direction! Redlevel by adjust the supports ~~and~~
gap.

EXP # 68

+ Period 50.4 sec \rightarrow 15.92 ϕ
Gained React!
Small gap at bottom

Straighter Purchases

EXP # 69 (Repeat 68) (gain react.)

+ Period

gap appears
to be minimal

Tables to 10 Rev - To reduce power, repeat period

EXP # 70 (Repeat 69)

Movable stack appears to be lower than
fixed stack Same period
at 33.9 sec - 20.58 ϕ av

Removed top three layers of fuel and Ct_2
[3/16 - 3/8 - 1/4] a 10-20 mil diff.

Relveled and re tensioned rods, with
table @ 16 in.

EXP # 71

+ Period - (lost React) M. Stack appears
not level in E-W. w. respect to fixed stack.
110.8 sec \rightarrow 8.90 ϕ

2-21-67

Remove uranium except $\frac{3}{16}$, $\frac{3}{8}$, $\frac{1}{2}$
and start from the beginning to align
the uranium on fixed & movable tables.
Added tension rods on back of channels (unmistak)

2-22-67

After aligning Fixed Table (used precision level)

Placed 2 ea Pb bricks Dial Ind 92

No " " " " 99

50 lbs → 7 mils
deflection

After aligning Mov Table

Placed 2 ea Pb bricks Dial Ind 75.5

Removed " " " " 85.5

10 mils
deflection

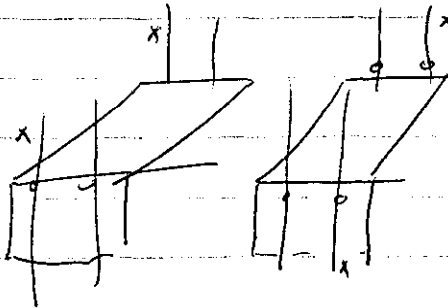
Instrument Check on 2-22-67 Source 10 mc Radium

PM-1	Low Trip	OK	^{He} Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	10×10^{-11}	Meter Trip	OK	Fast Trip	OK
IC-2	10×10^{-11}	Meter Trip	OK	Bkg alarm	
IC-3	1.4×10^{-10}	Calibration	OK	A	OK
IC-4	0.7×10^{-10}	Calibration	OK	B	OK
CRM		Meter Trip		C	OK

EXP # 72 (11¹⁵ AM)
 + Period 46.9
 16.71 ϕ

Touches at
 top, gap @ bottom

^{1/8 turn}
 Tightened tension on back supports to level top



uranium layer.

EXP # 73

12³⁰

+ Period = 23.9 sec
 = 25.28 ϕ

Appearance of gap
 is minimal!!!
 As good as ever

Remove $\frac{3}{32} \times 5 \times 5$ } Final half
 Add $\frac{1}{32} \times 5 \times 5$ }

EXP # 74 Subint. 25.3
 - Period 275.8 sec - 5.4¢
 30.7

U $\frac{1}{12} \times 5 \times 5$ worth 30.7¢

Remove $\frac{1}{32} \times 5 \times 5$ } U
 Add $\frac{1}{16} \times 5 \times 5$ } Final half

EXP # 75

+ Period 86.8 sec 10.76¢

Add $\frac{1}{16} \times 4 \times 5^+$ Al to Movable table

EXP # 76

+ Period 34.75 sec 20.26¢

Repeat EXP # 73

EXP # 77

Period same as # 73!

Remove Al $\frac{1}{16} \times 4 \times 5^+$

Remove $\frac{1}{16} \times 5 \times 5$ U

Add $\frac{3}{32} \times 5 \times 5$ U

$\frac{1}{16} \times 4 \times 5^+$ Al worth 9.5¢

$\frac{1}{32} \times 5 \times 5$ U

10.76	25.28
5.4	10.76
16.26¢	14.52
or	15.34¢

Size Measurements

South	North
4.102	4.112
4.104	4.105
4.102	4.105
4.100	4.100

Av. 4.104

$$\text{Base system} + 25.28 - 4 \times 9.5^{\text{38}} = -12.74$$

7 layer U @ 7/16 = 3 1/16 (3.0625) add 4ea 1/16 x 5 x 5 to #77

stacked with 2ea 1/16 x 5 x 10 in each layer
12ea 615 x 5 x 10

EXP # ~~77~~ 78

157.4
1249.9
1407.3

2:40 PM

+ Period 93.4 sec 10.184 Crack visible

$$U = \frac{92055}{93975}$$

	5 x 10	3 x 10 2 x 10	5 x 5
3/32	1/8		3/32
7/16		1/8 + 1/8	1/8 + 1/16
3/8	1/8		1/4
1/2		1/2	
3/8	1/8	1/4	
1/2	1/2		
3/16	1/4 + 1/8		1/16
1/32	1/8		3/32

EXP # 79 Straighten stack, mostly moved on al plate
Rev ~ 1.1 period to step to measure.

Remove 2ea 3/32 add 2ea 1/16 x 5 x 5. (Fixed)

EXP # 80

+ Period 1075, sec Slight crack
1.15 ϕ but not aligned.

Top not level Unload to half. Cut Mass on each table to level each half.

Instrument Check on Feb 23, 67 source 10m Radium &

PM-1	Low Trip	OK	Hi	OK
PM-2				
IC-1	Meter Trip	OK	Fast Trip	OK
IC-2	Meter Trip	OK		Bldg Alarm
IC-3	1.2×10^{-10}	Calibration	OK <u>swan</u>	A - OK
IC-4	1.2×10^{-10}	Calibration	OK <u>swan</u>	B - OK
CRM	Meter Trip			C - OK

EXP #81

12-13

Table scrambled at N rev.
 ERR could find no reason either. Therefore
 might assume a momentary power loss so
 that a relay dropped out.

Top layer has shifted $\sim 1/16$ " only.

EXP #82

Subcritical with gap - adj. stack

EXP #83 Same V as 80
 + Period 8.45

EXP #84 (Repeat #82)
 + Period 112.9 8.78

EXP #85 add $1/6$ $\times 4 \times 5$ al (E on Mov)
 + Period 40.2 18.484 \rightarrow 9.74 worth of al

EXP #86 Remove $1/16$ $\times 5 \times 5$ add $1/32$ $\times 5 \times 5$ (~~was fixed~~)
 + Period 506 \rightarrow 2.36

#87 Remove $\frac{1}{32} \times 5 \times 5$ Add $\frac{1}{16}$ to South West
 Corner - Remove $\frac{3}{32} \times 5 \times 5$ Add $\frac{1}{16}$ to North
~~West~~ West Corner, + Period 341 sec \rightarrow 3.39¢

Measurements on Symmetrical Stack see 079 Top layer missing

North	South	See $\frac{1}{32} \times 5 \times 5$
4.041	4.030	
.040	4.030	
.047	4.034	
<u>044</u>	<u>3.992</u>	
4.043	4.029	
Av 4.036		

#86-85 $\frac{1}{32} \times 5 \times 5$ worth 16.12¢

85-87 $\frac{1}{32} \times 5 \times 5$ worth 15.09

Use this because fuel layer change from $\frac{1}{16} \rightarrow \frac{3}{32}$

$$\begin{aligned} \text{Bare Assembly} &= \frac{\#83 + 84}{2} = 8.62¢ \\ &\quad \ominus 38.8 \quad \text{al cor} \\ &\quad + 30.18 \quad \text{U. cor} \\ &\quad \hline &\quad 0.0 \quad \phi \end{aligned}$$

$$k_{\text{eff}} \text{ Bare Assembly } 3.0625 = 1.000$$

red
 \rightarrow

3 layer stack 3.00 in

6 ea $\frac{1}{16}$ 5x10 CH_2 total 36ea x 44.63846
 = 1607.0g CH_2

U-inventory on stack

	5x10	$\frac{3 \times 10}{2 \times 10}$	5x5	5x10	$\frac{3 \times 10}{2 \times 10}$
$\frac{1}{2}$			$\frac{1}{2}$		
1	$\frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8}$	$\frac{1}{8}$	$\frac{1}{4}$	← Mov $\frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8}$	$\frac{1}{8} + \frac{1}{8}$
1	$\frac{1}{4}$	$\frac{1}{2} + \frac{1}{4}$			
$\frac{1}{2}$	$\frac{1}{2}$				

0954 Net used $\frac{1}{8} \times 5 \times 10$
 1076 3x10
 1041 2x10

15,319
 9,197
 6,138
 15,333
 7,681
 4,606
 3,059
 7,670
 $\frac{1}{8} \times 5 \times 10 = 17,293$
 3,478
2,315
 9,2089

EXP # 88 Super critical - too much for period meas.
 Crit ~ 2.6 Rev.

Remove $\frac{1}{8} \times 5 \times 10$ on each half 1064 1065
 Add 4ea $\frac{3}{16} \times 5 \times 5$ 1912 1921 1950 1951
 Placed 6ea $\frac{1}{8} \times 5 \times 10$ on top
 4ea $\frac{1}{2} \times 5 \times 5$ in 2nd U layer from top.

EXP # 89
 + Period 27.15 sec
 23.50 c

#90 Remove $\frac{3}{32} \times 5 \times 5$ add $\frac{1}{16} \times 5 \times 5$
 8.35¢ (Southeast)
 $\frac{23.50}{15.15¢}$ worth of $\frac{1}{32} \times 5 \times 5$ fuel

#91 Add $\frac{1}{16} \times 4 \times 5^+$ (North east)
 + Period 18.48¢

Al worth 10.13¢ x 4.

Symmetrical Assembly 3.00		S	Meas	N
89	23.50	4.096		4.100
	+40.52	91		98
		88		95
	+60.60	96		97
	<u> </u>	<u> </u>		
Base	+43.58	Av 4.095		
	<u> </u>			

10 mr @ 3 ft

Checked IC-4 bare with 10 mr of source 3.08

contact	3.2×10^{-10}	
---------	-----------------------	--

1 ft	2.0×10^{-11}	→
------	-----------------------	---

2 ft	6.0×10^{-12}	
------	-----------------------	--

$$90 \text{ mr} \times \left(\frac{12}{4.5}\right)^2 = 61.6 \text{ mr/h}$$

$$22.5 \text{ mr} \times \left(\frac{24}{26.5}\right)^2 = 18.46 \text{ mr/h}$$

3.076

PM-1	Low Trip	OK	Hi Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	Meter Trip	OK	Fast Trip	OK
IC-2	Meter Trip	OK		Blay alarm
IC-3	9 x 10 ⁻¹¹ Calibration	AWM		A - Relay chattering did not stop on
IC-4	Response OK Calibration	AWM		B - "
CRM	Meter Trip			C - OK

3.1875 U Metal 3 layers stacked with 3ea 76 ch₂
2ea 015 ch₂

	5 x 10	3 x 10 2 x 10	5 x 5	803.5 134.9
$\frac{17}{32}$	$\frac{1}{8} + \frac{1}{8} + \frac{1}{8}$		$\frac{2}{32} + \frac{1}{16}$	938.4
$\frac{17}{16}$		$\frac{1}{4}$	$\frac{1}{2} + \frac{1}{4} + \frac{1}{16}$	
$\frac{17}{16}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{16}$	184
$\frac{17}{32}$	$\frac{1}{4} + \frac{1}{8}$		$\frac{3}{32} + \frac{1}{16}$	

$\frac{1}{8} \times 5 \times 10$ (all but 1065 - 0954)	15354	Measurements on stack South North
$\frac{1}{2} \times 5 \times 10$	15319	
$\frac{1}{2} \times 3 \times 10$	15.335 < 9197	
2 x 10	6138	
$\frac{1}{2} \times 5 \times 5$	15333	
$\frac{1}{4} \times 5 \times 10$	7681	
3 x 10	4606	
2 x 10	3059	
5 x 5	7670	
$\frac{3}{32} \times 5 \times 5$	5719	
	7680	$\frac{58}{8} = 7.25$
16 ea $\frac{1}{16} \times 5 \times 5$	97756	3.847

EXP #92

Approach to Critical scrambled
because scale not changed on IC-2.

Rev counter @ 2.2 and on positive period

Super critical --

straighten up the screen

EXP #93

Removed $\frac{1}{16} \times 5 \times 5$ } Fixed
added $2 \times \frac{1}{16} \times 5 \times 5$ } Table

+ Period 24.4 sec \rightarrow 24.99¢

EXP #94

Remove $1 \times \frac{1}{32} \times 5 \times 5$ [SW]

+ Period 134.7 sec \rightarrow 7.61¢

EXP #95

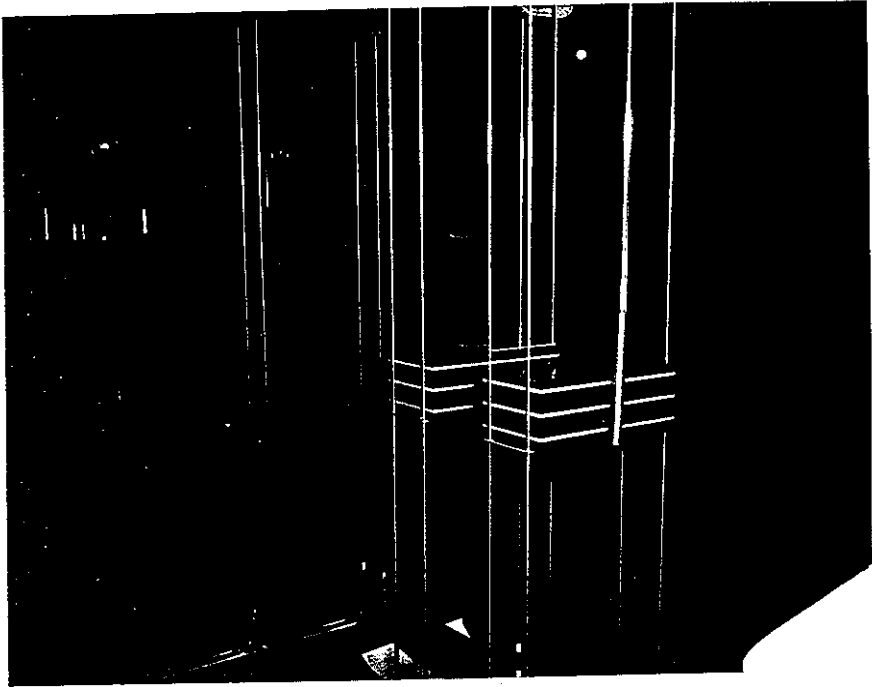
+ Period 39.5 sec \rightarrow 18.69¢

Al worth

$$95 - 94 = 1608¢$$

Fuel Worth

$$93 - 94 = 17.38¢$$



7

Reactivity of bare Symmetrical System meas

24.99

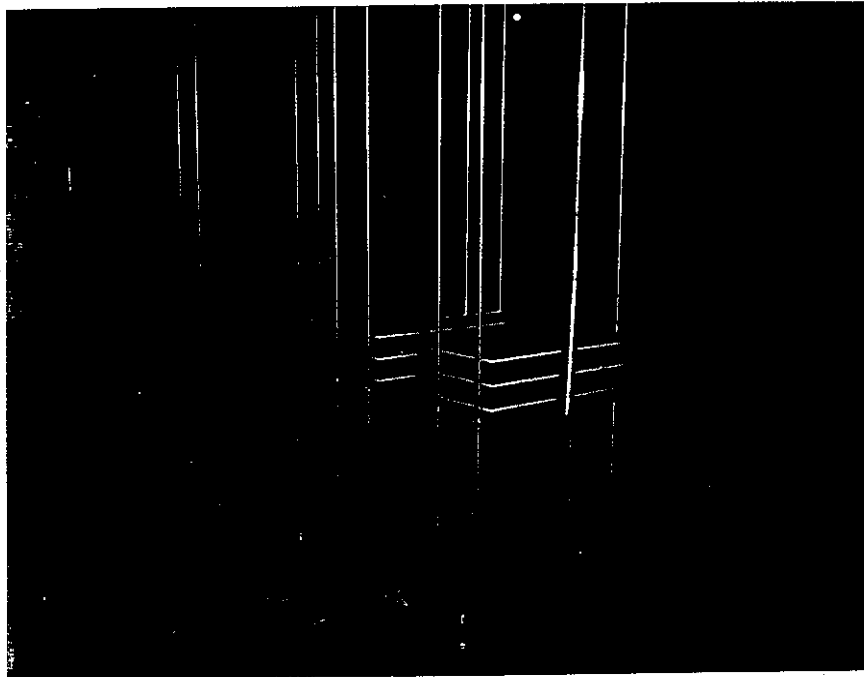
exp 85

+ 37.38

62.37

- 44.32

+ 18.05%



88

(Belongs on P. 92)

Instrument Check on 2-27-67 Source 10mc γ (Radium)

PM-1		Low Trip	OK	Hi Alert Trip	OK
PM-2				Alert Trip	
IC-1	10×10^{-11}	Meter Trip	OK	Hi Trip	OK
IC-2	10×10^{-11}	Meter Trip	OK		Bldg alarm
IC-3	1.8×10^{-10}	Calibration	OK		A OK Flicker
IC-4	1.2×10^{-10}	Calibration	OK		B OK "
CRM		Meter Trip			C OK

Febr 27, 1967

Stacked 5 layers @ $\frac{1}{2}$ " ea with $\frac{1}{4}$ " + 3ea $\frac{1}{16}$ " CH_2 all but top layer of CH_2 and $\frac{1}{4}$ in. U. (should be subcrit)

EXP #97

Subcritical

(Stack is tapered, gaps at bottom)

5 layer array (0.5) = 2.500 uranium

Stacked with 5 layers $\frac{1}{4} \times 5 \times 10$ CH₂ 1864.25%

expected to be subcritical.

EXP #96 - - Subcritical low multiplication

	5x10	3x10	5x5
	2x10		
$\frac{1}{4}$	$\frac{1}{8} + \frac{1}{8}$		
$\frac{1}{2}$	$\frac{1}{8} + \frac{1}{8}$	$\frac{1}{4}$	
$\frac{1}{2}$			$\frac{1}{2}$
$\frac{1}{2}$		$\frac{1}{2}$	1/2
$\frac{1}{2}$	$\frac{1}{2}$		
$\frac{1}{4}$	$\frac{1}{4}$		

$$8 \times \frac{1}{8} \times 5 \times 10 = 15354$$

$$\frac{1}{2} \text{ (del)} \quad 45987$$

$$\frac{1}{4} \quad 5 \times 10 \quad 7681$$

$$\frac{1}{4} \quad 3 \times 10 \quad 7665$$

$$\frac{1}{4} \quad 2 \times 10$$

$$\underline{76687}$$

Restack with 1ea $\frac{1}{4}$ and 3ea $\frac{1}{16}$ 30x 44.6785 = 1339.2

See page 88 for Exp #97

CH₂ 3193.5

Remove 2 layers - level with tables together. Restack as above

EXP #98 $\frac{1}{4} + 3 \times \frac{1}{16}$ CH₂

Super critical Tables @ 2.8 Rev. + Rev. 1

Remove $\frac{1}{8} \times 5 \times 10$ add 2ea $\frac{3}{32} \times 5 \times 5$ (Sand)
FIXED

EXP # 99 Supercritical
+ Period @ 2.3 Rev

Remove. $\frac{1}{8} \times 5 \times 5$ Add $2 \times \frac{1}{16} \times 5 \times 5$ on North
(Morr)

EXP #100
+ Period 38.2 sec \rightarrow 19.10 ϕ

Restack with full $\frac{1}{4}$ uranium in top layer but
with $\frac{1}{4}$ + $2 \text{ea } \frac{1}{16}$ + $3 \text{ea } 0.15$ (remove $\approx .075 \text{ CH}_2$)
in top CH_2 layer

EXP #101
+ Period 79.8 sec \rightarrow 11.47 ϕ

Restack with $1 \text{ea } \frac{1}{4}$ $2 \text{ea } \frac{1}{16}$ $3 \text{ea } 0.15$ CH_2 in each layer
5 layers @ $\frac{1}{2}$

EXP #102
+ Period Slight crack at Bottom

Fixed stack not level, leveled,
Removed $\frac{1}{8}$ in fuel Added $2 \text{ea } \frac{3}{32} \times 5 \times 5$ (South)

EXP #103
+ Period 186.1 \rightarrow 5.80 ϕ Minimum gap!

EXP #104 Add $\frac{1}{32} \times 5 \times 5$ fuel South
 + Period 37.8 sec \rightarrow 19.22

EXP #105 Remove $\frac{1}{32} \times 5 \times 5$ fuel at $\frac{1}{16} \times 4 \times 5$ N
 + Period 67.3 \rightarrow 13.00

Fuel worth 19.22
 5.80

 13.424
 x.

al worth 13.00
 5.80

 8.204
 x 4

 32.8

Reactivity of Bare System

#104 \rightarrow 19.22
 13.42

 22.64
 32.8

Meas.

	S	N
	4.600	4.604
	02	597
	595	610
	602	602
av	4.602	

$\Delta k = \text{---} 0.16 \phi$

$\frac{1}{4}$ $\text{CH}_2 = 1864.3$
 20 % 892.8
 30 0.015 337.3

 3094.4 g CH_2

125
 125
 045

 270

$\frac{1}{4}$ " x 5 x 10 CH₂

No.	wt	No.	wt
1	186.28	21	
2	186.48	22	184.69 4100.74
3	184.45	23	185.74 4286.48
4	186.58	24	186.81 4473.29
5	185.77	25	185.91 4659.20
6	186.78	26	186.38 4845.58
7	187.44	27	185.32 5030.90
8	186.18	28	182.98 5213.88
9	188.24	29	186.18 5400.06
10	186.08	30	184.71 5584.77
	1864.28		
11	186.47 2050.75	31	183.43 5768.20
12	186.48 2237.23	32	186.19 5954.39
13	186.10 2423.33	33	182.65 6137.04
14	187.71 2611.04	34	185.07 6322.11
15	187.74 2798.78	35	186.50 6508.61
16	186.00 2984.78	36	185.90 6694.51
17	186.92 3171.70	37	185.34 6879.85
18	185.11 3356.81	38	185.68 7065.53
19	186.14 3542.95	39	184.35 7249.88
20	186.47 3729.42	40	186.15 7436.03
21	186.63	41	183.02 7619.05
	3916.05	42	185.80 7804.85
	vs		3888.80
	3915.5		vs
			3888.3
			Average 185.83

Restack $\frac{1}{2}$ " layer 4 layer - 2.00 total
 with 3ea $\frac{1}{4} \times 5 \times 10$ except top $\frac{3}{4}$ Ctes.
 No 1-24
 = 4473.3 g CH_2 and $\frac{1}{4}$ U

EXP #106

Subcritical

Add Top layers

EXP #107

Subcrit - period	234			
	4606			
with gap,	3059	$\frac{1}{4}$		
	15333	$\frac{1}{2}$		$\frac{1}{2}$
	9197	$\frac{1}{2}$		
	6138	$\frac{1}{2}$		$\frac{1}{2}$
straighten & add	15319	$\frac{1}{2}$	$\frac{1}{2}$	
2ea $\frac{1}{16} \times 5 \times 10$ (1 on N ions)	7681	$\frac{1}{4}$	$\frac{1}{4}$	
CH_2	01333			

Exp #108

+ Period Tables @ 1.7 Rev

Remove 2 $\frac{1}{16} \times 5 \times 10 \text{ CH}_2$ Add 1ea $\frac{1}{32} \times 5 \times 5 \text{ U}$

EXP #109 Subcritical

Systems has gap when closed

Unstack to $2\frac{1}{2}$ U layers and
 align with tables together

Instrument Check on Feb 28 Source 10mc γ

PM-1	Low Trip	OK	Hi Trip	OK
PM-2			Alarm Trip	
IC-1	Meter Trip	OK	Fast Trip	OK
IC-2	Meter Trip	OK		Bldg alarm
IC-3	9×10^{-11}	Calibration JWM		A - Flicker
IC-4	1.3×10^{-10}	Calibration JWM		B - "
CRM	Meter Trip			C - OK

8⁴⁵ EXP #10. Sub crit (without $\frac{1}{32} \times 5 \times 5$)
 - Neg Period Ass. has gap at bottom touching at top on E end.

9¹⁵ Straighten assembly - add $\frac{1}{32} \times 5 \times 5$ fuel S.E.

EXP #111.
 + Period ~~202.7 sec~~ $+5.39 \phi$ $\rightarrow 5.39 \phi$

add $\frac{1}{16} \times 4 \times 5^+$ AL on N.E.
 EXP #112 worth AL
 + Period + 77.8 sec $\rightarrow +11.69 \phi$ 6.30 ϕ

Remove ~~rod~~ $\frac{1}{32} \times 5 \times 5$ U worth of U
 EXP #113 12.79 ϕ
 - Period - 12.08 sec $\rightarrow -1.10 \phi$
 React of Ass w/ $\frac{1}{16} \times 4 \times 5^+ AL = -1.1 - 6.3 = -7.4$

Measurements.

N	5.007	S	5.000
	5.009		4.998
	5.012		5.010
	5.010		5.004

 Aw = 5.006

Restack — w. \varnothing 2 ea 015 x 5 x 10 piece
in top layer CH_2 (3 ea $\frac{1}{4}$ + 1 ea 015 thick)

No Aluminum on Top.

10³⁷ EXP # 114 (Burst preceded this exp)
+ Per 136.8 + 7.47 ϕ

worth of Plastic = $\frac{1.1 + 7.47 + 6.3}{14.87\phi}$

Mass S 5.016
12
18
24

N 5.027
30
29
28

$\bar{A}_w = 5.023$

Bare Exp 61,333 g $\text{U}_{31.5}$ + 4473.29 g CH_2
- 1.6 ϕ - 5 x 6.30 ϕ = -32.6 ϕ

React + 7.47 ϕ
- 4 x 6.3 = 25.2
- 17.77 ϕ

with 22.4 g of plastic
added to top layer
 $\text{CH}_2 =$

5.023

8 layers @ 1/4 = 2.00 U

		5x10	3x10 2x10	5x5
	1/8	1/8	⊙	
	1/4		1/8	1/8
	1/4	⊙	1/8	1/16 + 1/16
envel	1/4	1/8		1/16 + 1/16
	1/4	1/8 + 1/8		
	1/4			1/4
	1/4		1/4	
	1/4			
	1/8	1/4		
	1/8	1/8		

40ea	1/8 x 5x10	19197	chk ✓
4ea	1/8 x 3x10	4623	Nos 1-16 1/4 x 5x10
	1/8 x 2x10	3083	
2ea	1/4 x 5x10	7681	
2ea	1/4 x 3x10	4606	
	1/4 x 2x10	3059	
4ea	1/4 x 5x5	7670	
4ea	1/8 x 5x5	3845	
16ea	1/16 x 5x5	<u>7680</u>	
		61444	

EXP #115 Stacked with 1ea 1/4 + 2ea 1/16
or 3/8 in

Subcritical - low Mult.

EXP #116 Add 4ea x 1/16 x 5x5 - 1920g

Straightened Assembly Remove 4lea $\frac{1}{32} \times 5 \times 5$
 Add 7lea $\frac{3}{32} \times 5 \times 5 = 28.56$
 61.44

 64.300

EXP # 117
 - Period ~ 108 ^{7.9} sec -22.05ϕ
 ~~$+2.6 \phi$~~
 Small gap on East

1:45 PM (Burst)

Straighten Ass Add 2lea $\frac{1}{32} \times 5 \times 5$ $\frac{480}{61.780}$
 EXP # 118
 - Period 8.47 sec -1.58ϕ Small gap on West ^{lower}

Untack Ass. to $5\frac{1}{2}$ U layers and realign
 EXP # 119 (Same as 118)
 + Period 79.95 $+11.46 \phi$ Minimum gap _{in crack}

Remove 1lea $\frac{1}{32} \times 5 \times 5$ U 64.500
 EXP # 120
 - Period 3680 sec $= -0.35 \phi$

Add 1lea $\frac{1}{16} \times 4 \times 5$ + al ^{width of full} 11.81ϕ
 EXP # 121
 + Period 170 sec $\rightarrow 6.26 \phi$ width of A $= +6.61 \phi$

Measurements on system with $\frac{3}{32}$ extra layer on top

S	5.088	N	5.087
	89		77
	92		79
	92		92

Av 5.087

Reactivity of Bare system symmetrical without $\frac{3}{32}$ layer

~~3~~ Fuel $\frac{7}{32}$ 10×10

$\frac{4}{32}$ 5×5 (EXP ± 120)

$$13ea \times 11.81 = 153.53 \neq$$

$$4ea \times 6.61 = 26.44$$

.35

180.32

$\nu \# 1.8$ subcritical ± 0.50 because

of large amt of fuel treated as $\frac{1}{32}$ layers.

OH ₂ weight	16ea $\frac{1}{4}$	2984.8	.25
	32ea $\frac{1}{16}$	<u>1428.4</u>	.125
		4413.2	

Instrument Check on Mar 1, '67 Source 10 mc (Red X) 109

PM-1	Low Trip	OK	HI	Alarm Trip	OK
PM-2				Alarm Trip	
IC-1	10×10^{-1}	Meter Trip	OK	Fast Trip	OK
IC-2		Meter Trip	OK		Blg alarm
IC-3	1.7×10^{-10}	Calibration			A Flicker
IC-4	1.3×10^{-10}	Calibration			B "
CRM		Meter Trip			C - OK

Temp $\sim 23.6^\circ \text{C}$

Restacked assembly with 8 layers @ $\frac{1}{4} = 2.00 \text{ V}$
+ 1ea $\frac{1}{4}$ + 2ea $\frac{1}{16}$ + 1ea 0.015 CH_2 per layer

9³⁵ AM EXP #122 — low Mult, (2x15" IC-4)

Subcritical — — gap in assembly

Straightened assembly, add 2ea $\frac{3}{32} \times 5 \times 5$
1912 + 1921

9⁵⁰ EXP #123

+ Period 214.5 sec \rightarrow 5.12 ϕ Small gap in Assembly

Straighten Assembly (Repeat 123 for react change)

10¹⁴ EXP #124

+ Period 56 sec \rightarrow + 14.81 ϕ

Straighten Assembly EXP #125 (last react)

+ Period 82.5 sec \rightarrow + 11.19

Remove $1\frac{1}{2} \text{ V}$ + 2 CH_2 layers and
close tables to align assembly, Separate
for final ^{stacking of} assembly.

EXP #126

+ Period + 31.1 sec + 21.69 ϕ

MIN Gap

EXP #127 Remove $\frac{3}{32} \times 5 \times 5$ U (South West)
 Add $\frac{1}{16} \times 4 \times 10^+$ Al (North)
 + Period -814.5 sec → -1.64 φ

EXP #128 Add $\frac{1}{16} \times 5 \times 5$ U (Southwest)
 + Period +28.6 sec → +22.80 φ

Remove $\frac{1}{16} \times 4 \times 10^+$ Al

1⁵³ PM EXP #129
 + Period +88.0 sec → +10.65 φ

worth of Al $\frac{1}{16} \times 4 \times 10^+$ = 12.15 φ
 worth of $\frac{3}{32} \times 5 \times 5$ = 21.69
 1.64
 12.15

 35.48 φ

worth of $\frac{1}{16} \times 5 \times 5$ = 22.80
 1.64

 24.44 φ

Measurements

South	North
5.121	5.124
126	5.123
126	115
131	115
5.121 <u>av</u>	

Rest of Bare Assembly w.o. $\frac{3}{32}$ find
 -1.64
 -36.45
 -35.48

 -73.57 φ

$$C_{H_2} = 1622 \times 11.2445 = \begin{array}{r} 179.9 \\ 4413.2 \\ \hline 4593.1 \end{array}$$

red

Restack 4 plastic layers 1ea $\frac{1}{4}$ 2ea $\frac{1}{16}$ 2ea 0.015
 (same) a " " 1ea $\frac{1}{4}$ 2ea $\frac{1}{16}$ 1ea 0.015
 8 U Layers $\frac{1}{4} = 2.00$ in U total

Mar 1
 2²⁴ PM

EXP #130

- Period - 664.6 sec \rightarrow - 2.04 ϕ

MIN. Gap

par excellence

2⁴⁸ PM

Add $\frac{1}{16} \times 4 \times 10^+$ AL pc. (North)

EXP #131

+ Period 100.3 sec \rightarrow + 9.63 ϕ

1ea $\frac{1}{16}$ 2984.8

32 $\frac{1}{16}$ 1428.4

24 0.015 269.9

4683.1

Remove $\frac{1}{16} \times 4 \times 10^+$ AL (North)

Add $\frac{1}{32} \times 5 \times 5$ (South) (East)

EXP #132

+ Period + 101.65 sec \rightarrow + 9.53 ϕ

worth of AL $\frac{1}{16} \times 4 \times 10 = 9.63$

- 2.04

11.67

Measurements

South

5.192

176

182

191

North

.182

182

180

179

worth of $\frac{1}{32} \times 5 \times 5 U = 11.67$

- .1

11.57 ϕ

5.183 Ave

Rest of Bare Assembly

- 2.04

- 23.34

- 25.38 ϕ

Re stack in 4 layers using same material as in EXP #122. (Doubling C_H and U layer thickness (8 pc 015 removed from EXP #130-132))

- C_H 2 1/4
- 1 015
- 2 1/16
- 1 1/4
- 1 015
- 2 1/16

Uranium

	5x10	3x10 2x10	5x5
1/4	1/8 + 1/8		
1/2	1/8	1/8 + 1/8	1/8
1/2	1/8		1/4 + 1/16 + 1/16
1/2	1/8	1/4	1/16 + 1/16
1/4	1/4		

EXP #133

+ Period .83.1 → +11.13¢ Small gap in middle layer of assembly

Straighten Stack

120

Instrument Check on Mar 2, 67 Source 10 mc γ (Radium)

PM-1	Low Trip	OK	Hi Trip	OK	
PM-2			Alarm Trip		
IC-1	10×10^{-11}	Meter Trip	OK	Fast Trip	OK
IC-2	10×10^{-11}	Meter Trip	OK		
IC-3	1.1×10^{-10}	Calibration	DW/M		
IC-4	9×10^{-11}	Calibration	DW/M		
CRM		Meter Trip			

8³⁶ EXP # 134
+ Period

(MIN gap)

Separate completely

~~Use Al + Fuel evaluation of EXP 122-129
React Bare Ass~~

~~-24.30 =~~

av 22.8 sec

26.0 ϕ

EXP #135 (Repeat 134)
+ Period

Measurements

S	5.120	N	5.125
	113		122
	121		118
	125		116

av 5.118

Observed several gaps between 5×5 pieces
and therefore believe that some reactivity could
be gained by removing top layer and bringing
tables together to align assembly. $\frac{1}{2}$ U layer
+ 1 CH_2 layer removed. Tables
brought together remotely. — —

953
AM

EXP #136

gained React.

+ Period $\frac{3.0 \text{ div}}{6 \text{ d}}$

EXP #137 (Repeat after 45' decay)

no source starting - Multiplication
detected with tables @ ~ 3.0 rev separation
still plenty of delayed neutrons or source
neutrons leaking from source P.B.

+ $\frac{2.8 \text{ div}}{6 \text{ decade}}$

$$\text{Average } \frac{2.9}{6} = 4833 = 10.50 \text{ sec} \rightarrow 38.30 \text{ } \phi$$

- 24.30

$$\text{Bare System React} = +14.0 \text{ } \phi$$

Restack 6 layers @ $\frac{1}{4} = 1.50 \bar{U}$

Estimated CH_2 layer thickness 2ea $\frac{1}{4}$ + 2ea $\frac{1}{16}$

	5x10	$\frac{3 \times 10}{2 \times 10}$	5x5	
$\frac{1}{8}$			$\frac{1}{8}$	U
$\frac{1}{4}$	$\frac{1}{8} + \frac{1}{8}$			332
$\frac{1}{4}$	$\frac{1}{8} + \frac{1}{8}$			19197
$\frac{1}{4}$				7681
$\frac{1}{4}$			$\frac{1}{4}$	4606
$\frac{1}{4}$		$\frac{1}{16}$		3059
$\frac{1}{4}$				7670
$\frac{1}{4}$	$\frac{1}{4}$			3845
$\frac{1}{8}$	$\frac{1}{8}$			<hr/>
				46058

Without top layer CH_2 and $\frac{1}{8} \bar{U}$ layer

EXP # 138 — Subcritical

align with tables together

Add top layer

EXP # 139 — Subcritical

IC-4 6×10^{-12} } low Mult.
 IC-3 5×10^{-12} }

Restack with 2ea $\frac{1}{4}$ + 2ea $\frac{1}{16}$ + 2ea 0.015
 in each layer.

$\frac{1}{4} \text{CH}_2$ 1-24	4473.3
24ea $\frac{1}{16}$	1071.3
24ea 0.015	269.9
	<hr/>
	5814.5

Dosi meters

Truck Door

3' ~~3 1/2~~ feet off floor

200 and 200+ m

Near Assembly

on East rail ~~Area~~
or plan of separation

40 & 45 m

Burst @ 1:00 PM Mar 2, 1967

EXP # 140 Sub critical

Min Gap

low Multiplication,

IC-3 7.5×10^{-12} 4 7.5×10^{-12} Add 1/8 x 5 x 10 on north and South tables

EXP # 141

+ Period 38.9 sec \rightarrow 18.88 ϕ

Restack with 2ea 1/4

4473.3

3ea 1/6

1071.3

535.65

6080.3

Cttr

EXP # 142

Sub critical

Source Mult $\sim 5 \times 10^{-11}$ in 150 sec.

Neg Period 700 steps.

MINGAP

Per
excellence

Add 4ea 1/6 x 5 x 5 U

EXP # 143 Super crit

3.0 Rev

Remove 2ea $\frac{1}{16} \times 5 \times 5$ (North Mox. Table)

EXP #144 Total U $46058 + 960 = 47018$

+ Period 30.6 sec $\rightarrow +21.9\%$

Remove 1ea $\frac{1}{16} \times 5 \times 5$ (from South Fixed)

Total U $46058 + 480 = 46538$

EXP #145 — CRITICAL

∞ Period

Add 1ea $\frac{1}{16} \times 4 \times 10^+$ Aluminum

EXP #146

+ Period 91.0 sec $\rightarrow +10.38\%$

~~Remove Top 3 plastic layers add 1ea 015 to each~~

~~1ea 015 $\times 5 \times 10$ added~~

Measurements

South	North	#144	#145	#146
5.606	5.600	+26.9	0	+10.38
594	590			
593	582			
601	590			

21.94 = $\frac{1}{16} \times 5 \times 5$
 1ea $\frac{1}{16} \times 5 \times 5$ + 2ea $4 \times 10^+$ Al
 bottom supports

Our 5.595

Bare Read = $0 - 21.90 - 20.76 = -42.66\%$

Mar 2

4:30 PM

Change Beckman Log N Y-119816 from normal power supply to Solar Power Supply in Cabinet 7 Rack

1967

Restack with 1ea 0.015 CH₂ in top 3 layers
6ea 0.015 x 5 x 10 added

Instrument Check on Mar 3, 67 Source 10 mc 8

PM-1	Low Trip	OK	HI Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	Meter Trip	OK	Fast Trip	OK
IC-2	Meter Trip	OK		Bldg alarm
IC-3	3.2×10^{-10} calibration	DOWN		A OK
IC-4	1.2×10^{-10} calibration	DOWN		B Flicker
CRM	Meter Trip			C OK

8¹⁵ AM EXP #147 -- Very long + period.

+ 1330. sec → 0.94 φ

EXP #148 -- With $\frac{1}{16} \times 4 \times 10^+$ Al Added

+ 86.4 sec → 10.80 φ

PIX
5-16
5ft

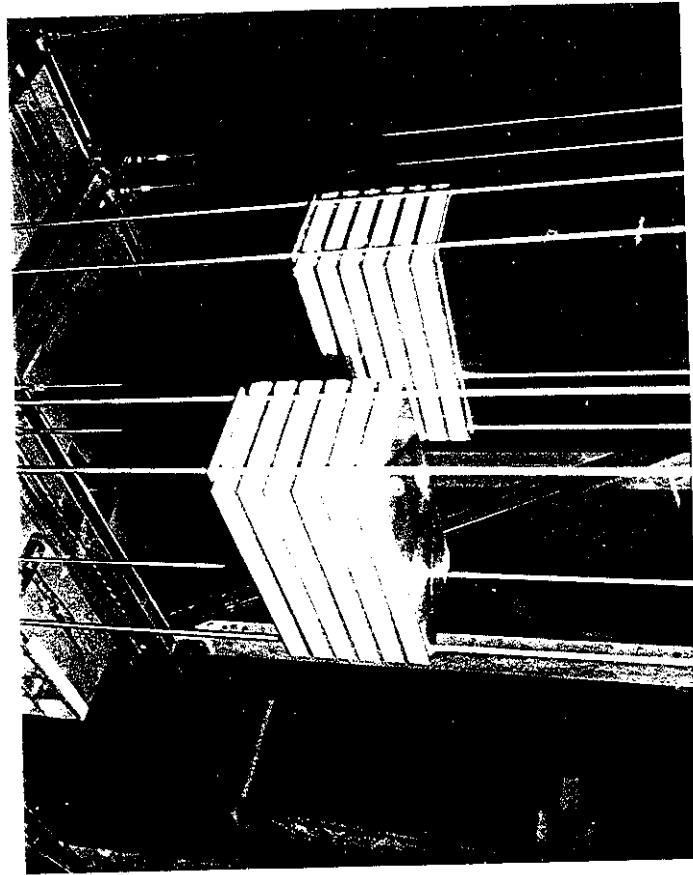
MIN Gap

EXP #149 -- With $\frac{1}{32} \times 5 \times 5$ U added (Al removed)

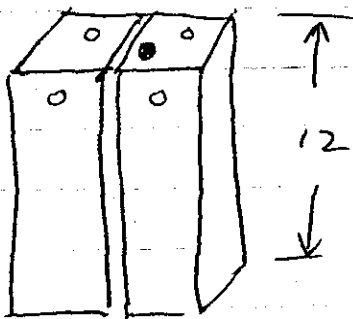
+ 75.2 sec → 11.99 (SE)

worth of $\frac{0.1}{\frac{1}{16} \times 4 \times 10^+} = 9.86 \phi$

" $U \times \frac{1}{32} \times 5 \times 5 = 11.05 \phi$



SPACER was made from 2 Al Boxes



which ^{when} bolted together formed a 3" x 6" x 12" spacer. This was inserted between halves of assembly and attempts to improve alignment. 3/16 al rods support the spacer

EXP # 150 Lost reactivity
- Period -164.4 → -10.47 d

gaps visible

Light Test probably the best Test of all.

Light behind assembly
Crack views thru window

Repeated alignment method

EXP # 151 appears to be in excellent contact. gains react ~ 84
+ 125.1 8.08

10³² Start shutdown for No Source Startup.

EXP # 152

+ Period

126.5

8.019

av 8.04 d

System shows multiplication before Tables Together. Source probably too large or pig leaks too many!

Reactivity of Bare Ass.

$$\begin{array}{r}
 = 8.044 \\
 2 \times 10.8 \quad - 21.60 \quad \text{al con} \\
 \hline
 - 13.564
 \end{array}$$

Measurements

South	North
5.646	5.639
42	25
45	35
50	42

$$\text{av} = 5.641$$

5×5 and $5 \times 5 = 5 \times 10$ Base Area

$$\frac{1}{16} \text{ pcs} \quad \frac{1065.85}{48} = \underline{\underline{22.2052}} \text{ g/pc}$$

$$0.015 \text{ pcs} \quad \frac{137.312}{24} = 5.7213$$

$$> \underline{\underline{5.778}} \text{ g/pc}$$

$$\frac{140.031}{24} = 5.8346$$

ESTIMATED $H_{crit} = 4.74 \text{ in.}$ from
Mihalzo mult. data.

Instrument Check on Mar 6 Source 10 mc 8

PM-1	Low Trip	OK	HI Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	Meter Trip	OK	Fast Trip	OK
IC-2	Meter Trip	Out of Service	Bldg alarm	
IC-3	1.4×10^{-10}	Calibration OK	A	OK
IC-4	1.2×10^{-10}	Calibration OK	B	Flicker
CRM	Meter Trip		C	OK

Placed 4ea $\frac{7}{8}$, 4ea $\frac{1}{2}$ 4ea $\frac{1}{4}$ 4ea $\frac{1}{8}$ 12ea $\frac{3}{32}$.
 EXP #153 4 $\frac{1}{16}$ " V X 5 X 10 base area

IC-1	$.05 \times 10 \times 10^{-11}$	26761
3	1.9×10^{-12}	15333
4	1.7×10^{-12}	7670
		3845
		8572
		62181

Little if any Mult, <2

Add 12ea $\frac{3}{32}$ X 5 X 5 = 8554
 EXP #154 (cell lot #2003) M 70735

IC-1	.115 / .04	3×10^{-11}	3
3	4.5 / 1.5	$\times 10^{-12}$	3
4	5.0 / 1.2	$\times 10^{-12}$	4

Sub-critical - Mult ~ 3-4.
 4 $\frac{7}{8}$ in. nom height

Add 4ea $\frac{1}{16}$ (2ea on N and S) 1920
 Now 4 $\frac{3}{4}$ nom. ht. 70735
 EXP #155 72652
 5

Subcrit	M
1 2.3 / .04	6
3 10 / 1.5	7
4 11 / 1.2	8

Add 4ea x $\frac{1}{16}$ x 5 x 5 (2 S & 2 N)
 EXP #156 Nom HT now $4\frac{7}{8}$ "
 Super critical 72 652 + 1920
 = 745725

Remove 2ea x $\frac{1}{16}$ x 5 x 5 (1ea N & S)
 Nom HT Now $4\frac{13}{16}$ "
 Straighten Assembly with 3" Sq Tubing
 between halves 74572
 960

EXP #157
 HT = 73,6175

Subcritical

EXP #158 Add 2ea $\frac{1}{32}$ x 5 x 5 480

+ Period 7.12.4 sec
 + 1.71 ϕ 74,092

Temp ~ 27°C

Very Small gaps

Gaps visible between the plates

(changed set point

77 → 72°F

(4020 hrs Red Light Timer)

Mar 7, 67 Restack Assembly with $\frac{1}{2}$ " plates on top and $\frac{1}{16}$ " and $\frac{3}{32}$ " plates on bottom.

480
 $\frac{1.6}{80}$
 2.80
 19.20
 90.

1ea $\frac{1}{32}$	Top	2ea $\frac{1}{32}$	480
1ea $\frac{7}{8}$		6ea $\frac{1}{16}$	2880
2ea $\frac{1}{2}$		24ea $\frac{3}{32}$	17126
2ea $\frac{1}{4}$		4ea $\frac{1}{8}$	3845
2ea $\frac{1}{8}$		4ea $\frac{1}{4}$	7670
12ea $\frac{3}{32}$		4ea $\frac{1}{2}$	15333
3ea $\frac{1}{16}$		4ea $\frac{7}{8}$	26761
1ea $\frac{7}{8}$	Bottom		746959

Instrument Check on Mar 7, 67 Source 10mc δ

PK-1	Low Trip	OK	Hi Hi Trip	OK	
PK-2			Alarm Trip		
IC-1	10×10^{-4}	Meter Trip	OK	Fast Trip	OK
IC-2	N.A. used	Meter Trip	X X	Re. OK	Bldg alarm
IC-3		Calibration	1.2×10^{-10}		A OK
IC-4		Calibration	1.2×10^{-10}		B Flicker
IC-5		Meter Trip			C OK

EXP # 159 Subcrit
 Source Mult to 5×10^{-11}
 $IC-4$
 $IC-3$ 4×10^{-14}

gap between
 Assembly Halves

- Period -124.9 sec -16.23 ϕ

Separate to $\sim 3\frac{1}{2}$ " use 3" tubing
 to align assembly halves.

EXP # 160 gamed React T = 26.5°C

- Period 344.2 sec \rightarrow 3.59 ϕ Small crack

(ERR replaced Tables in Temp Controller Station 72-77)

Aligned again

EXP #161 lost react. --- crack is larger?

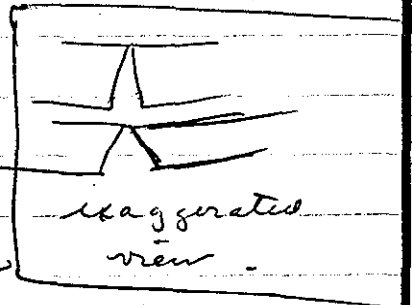
- Period 238.9 sec \rightarrow 6.42 ϕ

Remove $\frac{1}{32}$ & $\frac{7}{8}$ pieces from each half and reassemble for alignment.

Found each half not level so that there was a V shaped gap between each layer

Relevelled and realigned

Separated tables and reattached $\frac{7}{8}$ + $\frac{1}{32}$ pieces



EXP #162

26.5°C

∞ period 0 ϕ (no temp change yet)

Bare React 0
- 25.76

Add all $\frac{1}{16} \times 4 \times 5\frac{3}{4}$ (FIXED SOUTH)

EXP #163

+ Period +68.2 sec \rightarrow +12.85

Remove A2 - Remove $\frac{1}{32} \times 5 \times 5$ { SOUTH - FIXED HALF
Add $\frac{7}{8} \times 5 \times 5$

EXP #164

+ Period +40.0 sec \rightarrow 18.54

180
80
20
70

5°C
h

Measurements of Norm ²⁷ 4. ~~5~~ / 32

South

North

4.863

4.866

.867

4.856

.865

4.864

.864

4.863

Av 4.864 in.

$$B_x^2 = \frac{3.1416}{12.700} = .24737$$

$$\frac{4.2}{16.95} = .24785$$

$$B_y^2 = \frac{.34555}{.011265} = .30668$$

$$.045820$$

4.864

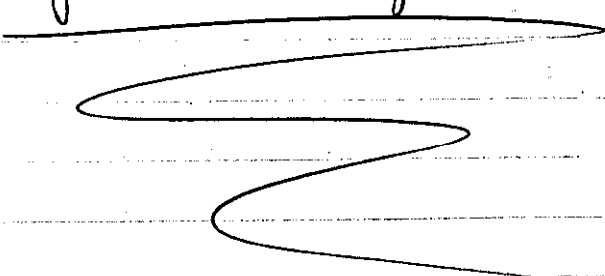
89²

4555²

$$\begin{array}{r} 4.56 \\ 9.092 \\ \hline 2.77 = 1.39 \end{array}$$

No.	WT(g)		No.	WT(g)	
1	92.116		21	93.043	1483.884
2	92.814		22	92.757	1576.641
3	92.986		23	94.184	1670.826
4	93.275		24	93.405	1764.231
5	93.514	464.705	25	92.881	1857.112
6			26	93.965	
7	92.898	557.603	27	92.756	
8			28	93.069	
9	92.322	649.925	29	93.550	
10	93.742	742.667	30	92.913	
11	92.513	835.180	31	92.875	
12	92.642	927.822	32	92.601	
13	92.739	1020.561	33	92.816	
14	92.411	1112.972	34		
15	93.023	1205.995	35	93.686	
16	93.023		36	93.374	
17			37	92.526	
18	92.331	1298.326	38	93.551	
19			39	93.364	
20	92.515	1390.841	40	92.640	
			41	92.520	
			42		

$\frac{1}{4} \times 5 \times 5$ in CH_2
plastic weights



5 layer @ $\frac{7}{8}$ = $35/8 = \text{~~4.375~~ } 4\frac{3}{8}$

$\frac{3}{32}$ {
 1993
 5
 6
 7
 8
 9
 2001
 2
 3
 } Not Used

$\frac{1}{4} + \frac{1}{8} + \frac{1}{16}$ Top

$\frac{2}{8}$
 $\frac{7}{8}$

4 ea $\frac{7}{32} + \frac{1}{2}$

4 ea $\frac{7}{32} + \frac{1}{2}$

$\frac{1}{4} + \frac{1}{16} + \frac{1}{8}$

Bottom

✓ 4 ea $\frac{7}{8}$	26,761	
✓ 4 ea $\frac{1}{2}$	15,333	Stacked with
✓ 4 ea $\frac{1}{4}$	7,670	2 ea $\frac{1}{16} + 2$ ea 0.015
✓ 4 ea $\frac{1}{8}$	3,845	in each layer
✓ 16 ea $\frac{3}{32}$	11,430	20 ea $\frac{1}{16} = 444.1$
✓ 4 ea $\frac{1}{16}$	1,920	20 ea 0.015 <u>115.6</u>
	<u>66,959</u>	g $\text{CH}_2 = 559.7$

Aligned assembly halves without top $\frac{1}{2}$ layers \cup

Exp #165 66,959 g \cup 5 layers 559.7g CH_2
 Subcritical — low multipl
 IC-3 2.3/1.1 = ~2
 -4 2.8/1.0 \approx 3

Restacked with 3 ea $\frac{1}{16}$ in each CH_2 layer
 30 ea x 22.205 = 666.2 g CH_2

156

EXP #166 66,959 g U (4³/₈) + 666.2 g LH₂
Sub crit low Mult.
IC-3 2.5 / 1.1 ~ n = 2.2
4 3.0 / 1.0 n ≈ 3.

Restacked with 4 layers 5 ea 1/16
1 layer 4 ea 1/16 + 4 ea 0.015

EXP #167
Sub crit

Added 4 ea 3/32 x 5 x 5
EXP #168
Sub crit

Added 2 ea 3/32 x 5 x 5

EXP #169
Sub Crit

Add 2 ea 3/32 x 5 x 5
EXP #170
+ Period 473.5 sec → 2.5 / φ

Continue
~~Return~~ to these exp. later

see page 169 for Inet Check
 Mar 10, 67 Stacked assembly with 2 ea $\frac{1}{4} \times 5 \times 5$ CH_2 layers

EXP #187 Stacked all but Top layer CH_2
 Subcrit, and $\frac{1}{2}$ T layer
 Found layers not uniform thickness
 Disassembled - measured thickness
 of CH_2 - Discarded nos 6, 8, 15, 17, 19
 because 10-15 mils thinner
 all Measured $\pm 2-3$ mils of 250.
 Discarded 42 and 34 also.

Restacked Assembly with CH_2 Nos 1-25
 except 6, 8, 15, 17, 19. Total weight = 1857.112
 Aligned tabs with $3\frac{1}{2}$ T + 3 CH_2 layers on each half.

EXP #188

Subcrit IC-3 7×10^{-12}
 4 1.0×10^{-11}

Restack adding 1 ea $\frac{1}{16} \times 5 \times 5$ CH_2 10cc = 222.1 g
 1857.1

EXP #189

2079.2g

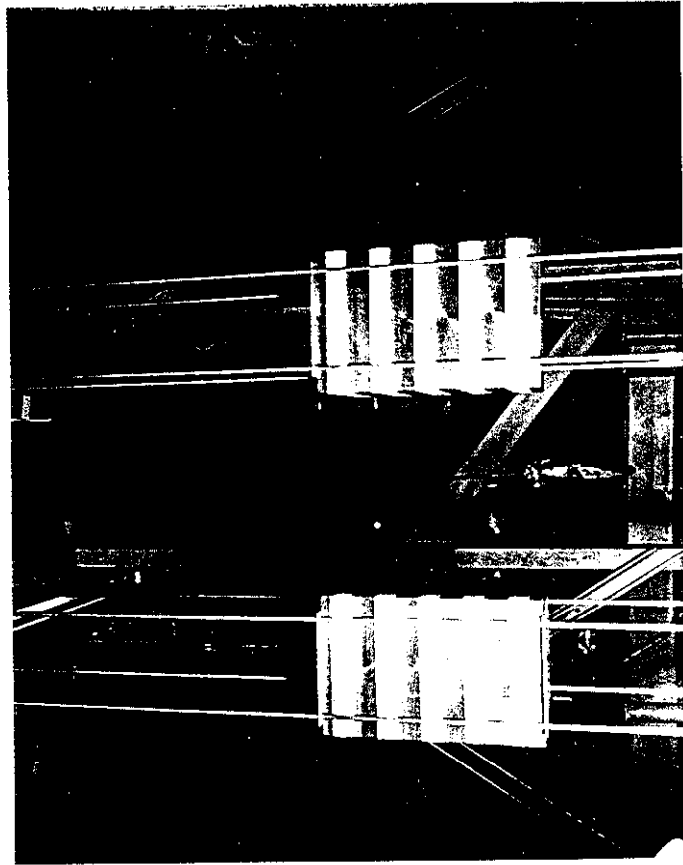
Subcrit IC-3 1.5×10^{-11}
 - 2.2×10^{-11}

add 2 ea $\frac{3}{32} \times 5 \times 5$ fuel.

EXP #190 + Period 1325 sec + 0.94 ϕ

130

T = 260°C



T = 26.0 °C

Gen $1/32 \times 5 \times 5$ EXP # 191 + Period 92.5 sec + 10.26 ϕ

Restack with 2ea $1/16 \times 5 \times 5$ (Sym Fuel) later found to
 now each layer 2ea $1/4$ Ctt 2 } be \pm high
 3ea $1/16$ Ctt 2 } on MOV
 Table

EXP # 192

Subcritical with large Crack

Separate to $\sim 3''$ align with \square tubing
 between halves

EXP # 193

+ Period 170.7 sec + 6.25 ϕ Add $1/16 \times 5 \times 5^{3/4}$ Alum,

EXP # 194

+ Period 86.9 + 10.75 ϕ Al worth 4.50 ϕ

$32 \times 5 \times 5$ instead of $1/16 \times 5 \times 5$ on
 MOV table. Mar 13, 1967

PM-1	Low Trip	OK	HI Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	10x10"	Meter Trip	OK	Fast Trip
IC-2	10x10"	Meter Trip	OK	Blky alarm
IC-3		Calibration	OK Swap	A OK
IC-4		Calibration	OK Swap	B No Trip
CRM		Meter Trip		C OK

T = 26.4 °C

Very Noisy

Found North (more or half with $\frac{7}{32}$ on top 1998 instead of $\frac{1}{16} \times 5 \times 5$ U. Therefore extra fuel of $\frac{1}{32} \times 5 \times 5$ on North. Replaced with $\frac{1}{16} \times 5 \times 5$ and repeat exp. with Sym U loading and $\frac{1}{10} \times 4 \times 5 \frac{1}{4}$ A on South half. (EXP #194 less $\frac{1}{32} \times 5 \times 5$ U) EXP #195 (Assembly was straightened also)

9¹⁴ AM

Subcritical - with large crack separate to ~ 3" (29.5) so that Aln tube can be used to straighten assembly.

9³⁵ EXP # 196

MIN Crack OK

- Period - 655.9 sec - 2.064

- 4.53

- 6.59

- 9.06

- 15.65 React

2523.4 OK₂

Meas

South North

7.780

7.817

73

12

77

06

80

08

7.778

7.811

31

7.780

Av = 7.779

Mar 13

10⁷AM

Restack with 2ea 1/4", 3ea 1/2" and 1ea 0.015 CH₂
 Assemble to ~3" for alignment with Tube.

EXP # 197

∞ Period

0 φ

Crack on Back Side

Straighten Assembly @ 3" Tube

EXP # 198

+ Period +275.8 sec + 4.11 φ

(gained 4.11 φ)

EXP # 199

Added 1/6 x 4 x 5 3/4 Q → 4.53 φ

+ Period +115.1 sec + 8.64 φ

4.11
 - 9.06

 4.95 φ

Mean	South	North
	8.862	8.872
	53	59
	55	58
	57	66

av = 8.860

↑ should be 7.860
 South
 Mar 15

CH₂ = 1857.1
 666.3

 57.8
 2581.2

U_{nom} = 4.375

CH₂ 5x .5
 .188
 .015

 .703

≈ 3.875

25
88
1
203

5.0

Restacked assembly with 1ea $\frac{1}{16}$ + 3ea 0.015 = $\frac{.1075}{5}$
 5 layers @ $\frac{15}{16}$ = $\frac{15}{16}$ = $4\frac{11}{16}$ = 4.6875

$\frac{15}{32}$ $\frac{3}{32} + \frac{1}{8} + \frac{1}{4}$ 5.225

$\frac{15}{16}$ $\frac{7}{8} + \frac{1}{16}$

$\frac{15}{16}$ $\frac{7}{8} + \frac{1}{16}$

$\frac{15}{16}$ $\frac{1}{2} + 4ea \frac{3}{32} + \frac{1}{16}$

$\frac{15}{16}$ $\frac{1}{2} + 4ea \frac{3}{32} + \frac{1}{16}$

$\frac{15}{32}$ $\frac{3}{32} + \frac{1}{8} + \frac{1}{4}$

		3 3
4 ea	$\frac{7}{8}$	26 761
4 ea	$\frac{1}{2}$	15 333
4 ea	$\frac{1}{4}$	7 670
4 ea	$\frac{1}{8}$	3 345
20 ea	$\frac{3}{32}$	14 272
8 ea	$\frac{1}{16}$	3 840

71,721

Instrument Check on Mar 8 Source 10mc

PM-1	Low Trip	Hi	Alarm Trip
PM-2			Alarm Trip
IC-1	Water Trip	OK	Fast Trip OK
IC-2			Bldg Alarm
IC-3	$\sim 1 \times 10^{-10}$	OK	A OK
IC-4	$\sim 1 \times 10^{-10}$	OK	B Flicker
CRN	Water Trip		C OK

Beider out

EXP #170

Subcrit IC-3 $\rightarrow 6 \times 10^{-12}$
 $4 \rightarrow 7 \times 10^{-12}$

large gap.

Straighten assembly, using 3" \square tubing spacerAdd 4 ea $\frac{3}{32} \times 5 \times 5 = 2854$

3:15 PM

EXP #172

71,721

+ Period $\rightarrow 72.1 \text{ sec} = 12.36 \phi$ 74,575 g U10 ea $\frac{1}{16} \times 5 \times 5$ 222.0530 ea $0.015 \times 5 \times 5$ (5.778) 17,334

39.54

 $\frac{6}{32}$ of U added To get assembly critical.Assume CH_2 necessary to be added is $\frac{1}{2}$ as effective. $\therefore 12/32 \text{ CH}_2$ needed or $3/8 = .375$ Each layer needs .075 \therefore add 1 ea $0.15 + \frac{1}{16}$ \therefore Restack with 2 ea $\times \frac{1}{16} \times 5 \times 5$ in each layer

one total of 30 ea 444.7

3 ea $0.025 = .1875$ + 2 ea 0.15 115.6

.9375

4.6875

5.625

559.7

Too much in 3 ea $\times \frac{1}{16}$

.125

0.30

1.55 $\times 5 =$

9.463

1.775 in

2.688

EXP #173

559.7 g CH_2 71,721 g USubcrit IC-3 6.7×10^{-12}

Instrument check on Mar 9 Source 10 mc ✓

IC-1	Low Trip	OK	H1	High Trip	OK
IC-2	Low Trip		High Trip		
IC-1	10×10^{-11}	OK	Fast Trip	OK	Records out
IC-2	10×10^{-11}	OK			Bldg Alarm
IC-3	1.3×10^{-10}	down			A OK
IC-4	1.3×10^{-10}	down			B Flicker
IC-5					C OK

Temp 26.5°C

Mar 9 9:00 Restacked w. Sea $\frac{1}{16} \times 5 \times 5$ Total $\text{CH}_2 = 40 \text{ ea} = 888.2$
 EXP #174
 Subcritical IC-3 $\rightarrow 1.2 \times 10^{-11}$
 -4 $\rightarrow 1.6 \times 10^{-11}$

Restack w. Sea $\frac{1}{16} \times 5 \times 5$ CH_2 (Top layer Sea $\frac{1}{16}$
 Sea 0.015)
 9:35 EXP #175
 48 ea $\frac{1}{16}$ 1065.9
 Total thickness 6.25 NOM. 8 ea 0.015 96.2
 measured $\approx 6\frac{1}{8}$ 1112.1g

Subcritical w. Crack
 IC-3 $\sim 2.6 \times 10^{-11}$
 4 3.6×10^{-11}

Separate tables to $\approx 3''$, use \square tubing
 to align, add $5 \times 5 \times \frac{1}{16}$ alum
 add $4 \times 5 \frac{3}{4} \times \frac{1}{16}$ alum
 add also 2 ea $\frac{1}{32} \times 5 \times 5$
 EXP #176 small gap.
 + Period 28.7 sec \rightarrow 22.75

Separate tables to 3" (29.3)

Straighten Assembly

Remove 5x5 Alum. on North

" 1/2 x 5 x 5 U on South

Sym Array has extra fuel 1/32 x 5 x 5 on N.
has AL 1/6 x 4 x 5 3/4 on S

EXP # 177

+ Period 206.3 Sec 5.31 ϕ

small crack
neglect

EXP # 178 Remove 1/32 x 5 x 5 U (North)
- Period -245.4 -6.21 ϕ

Replace 1/32 x 5 x 5 U, Remove 1/6 x 4 x 5 3/4 AL

EXP # 179

- Period -599.5 \rightarrow -2.27 ϕ

worth of AL	5.31 + 2.27 = 7.58	7.6
worth of U	5.31 + 6.21 = 11.52	15.2

Sym System	+ 5.31	
1 U	- 11.52	6.2
3 AL	- 22.74	
	<hr/>	
	- 28.95 ϕ	

Measurements

South

North

Restack with 1ea $\text{D.015} \times 5 \times 5$ added in each layer.

\equiv XP #180

- Period - 140.0 sec = -13.36¢

gap visible

Straighten Stack Add $\frac{1}{16} \times 4 \times 5\frac{3}{4}$ Al

EXP #181

+ Period + 437.4 \rightarrow +2.70¢

Remove Al. $\frac{1}{4} \times 4 \times 5\frac{3}{4}$ Add $\frac{1}{32} \times 5 \times 5$ U

EXP #182

+ Period + 141.2 sec \rightarrow +7.32

(Fuel - Al) worth 4.62 = .6¢

Remove U $\frac{1}{32} \times 5 \times 5$

T = 26.0°C

EXP #183

Sym System

- Period - 313.4 sec = -4.65¢

-4.65

-14.7

-19.35

Fuel worth = 11.97¢

Al worth 7.35

2al = 14.7

Restacked adding 1 ea 0.015 Cth₂ to each layer

Now 4 layers 5ea 1/16 2ea 10.015
 1 layer 4ea 1/16 6ea 0.015

EXP #184

+ Period +221.0 sec Very Small gap
 + 5.00 ¢

Min Crack

+5.00
 -14.5 ^{al}

 -9.5

EXP #185 with 1/16 x 4 x 5 3/4 Al

+ Period +73.0 sec + 12.25
 Al worth 7.25 ¢

EXP #186 with 1/32 x 5 x 5 U (Al removed)

+ Period +45.6 sec → + 17.03 ¢
 Fuel worth $\frac{5}{12.103}$ ¢

Measurements on system

4ea 1/16 + 1ea		4ea 1/16 + 2ea 0.015		4ea + 3e 0.015	
S	N	S	N	S	N
6.196	6.191	6.275	6.264	6.353	6.338
92	92	83	65	54	38
90	91	68	65	65	43
96	97	79	79	63	50
<hr/>		<hr/>		<hr/>	
Av. 6.193		Av. 6.272 TOP		Av. 6.351	

Instrument Check on Mar 10 Source 10m V

PM-1	Low Trip	OK	HI Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	10×10^{-11}	OK	Fast Trip	OK
IC-2	10×10^{-10}	OK		Beta Alarm
IC-3	1.1×10^{-10}	OK Alarm		A OK
IC-4	1.1×10^{-10}	OK Alarm		B - No TRIP
CRM	Meter Trip			C OK

See p 157. for exp #187
~~EXP # 187~~ Added for ~~0.075~~
~~to make by large North tank~~
~~correct amount of CH₂ Feasible~~
~~Test 0.075~~

0.015
 32
 N
 6.338
 38
 43
 50
 351

U-Metal - 7 layers @ $\frac{7}{8}$ " = $4\frac{1}{2}$ " U

Assembled with 2ea $\frac{1}{4}$ " + 2ea $\frac{1}{16}$ " CH₂ layers.

Check alignment with 3" \square Al Tube

EXP # 200

~~gap~~
~~gap~~

- Period -306.3 - 4.78 ϕ

~~Remove with 2ea $\frac{1}{4}$ " (1 2) ea. 4, 8, 15, 17, 19)~~

~~2ea $\frac{1}{16}$ "~~

Add $\frac{1}{16}$ " x 4 x 5 $\frac{3}{4}$ " Al

~~2ea 0.015~~

straighten stack

EXP # 201

Big Crack Visible, straighten

EXP # 202 w. Al on top on South. $\frac{1}{16}$ " x 4 x 5 $\frac{3}{4}$ "

+ Period +159. sec \rightarrow 6.63

~~EXP # 200 Measurements~~

135 PM EXP # 203 Remove Al on South

+ Period +1370.6 sec +.91 ϕ

gained read over
200 (5.694)

Al worth 5.72 ϕ

+ .91 - 11.44 = -10.53

Measurements

S	6.984	N	6.992
	91		90
	88		92
	80		89

Average 6.988

No. 1, 2, 3, 4, 5, 7, 9, 10

11, 12, 13, 14, 16, 18, 20, 25

1483.729

+ 355.28

1839.0

16 x 22.205 = 355.28

500
125

Rectack w. 2ea 1/4
 2ea 1/16
 1ea 0.015.

4 1/2" U
 16 } 1839
 16 } ~~7489.66~~ g
 8 46.22
~~1529.88~~
 Small Cracks
 1885.2

2³⁴ EXP #204
 + Period 29.5 sec 11.50¢

Straighteners.

EXP #205
 + Period +72.5 sec → 12.32¢ gained 0.82¢

Remove 1/16 x 5 x 5 U } North
 Add 1/32 x 5 x 5 U }

EXP #206
 + Period + 484.4 sec + 2.45¢ freshwork 9.87¢

Add 1/16 x 4 x 5 3/4 Alum.

EXP #207
 + Period +126.4 sec + 8.02¢ al worth 5.57¢

Measurements of height.

S	7.049	7.064
	43	56
	50	58
	<u>44</u>	<u>62</u>
	7.0465	7.060
	7.053 a	

				3	
Top	$\frac{2}{16}$	$\frac{1}{2} + \frac{1}{16}$	4 ea $\frac{1}{8}$	26	761
	$\frac{4}{8}$	$\frac{7}{8} + \frac{1}{4}$	4 ea $\frac{1}{2}$	15	333
	$\frac{1}{8}$	$\frac{7}{8} - \frac{1}{4}$	4 ea $\frac{1}{4}$	7	670
	$\frac{2}{8}$	$2 \text{ ea } \frac{1}{8} + 8 \text{ ea } \frac{3}{32} + 2 \text{ ea } \frac{1}{16}$	4 ea $\frac{1}{8}$	3	845
Bottom	$\frac{2}{16}$	$\frac{1}{2} + \frac{1}{16}$	16 ea $\frac{3}{32}$	11	430
			8 ea $\frac{1}{16}$	3	840
					<u>68,879</u>

March 14, 1967 8¹⁵ AM Clock 4042

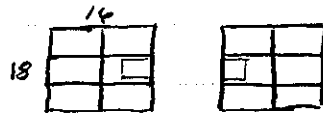
Febr 8, 1967 3939

103 hours

April 23 4067 hrs operation clock
 Polyethylene Reflected and Moderated Experiments

1st - - 5 x 10 base area fully reflected
 using 4.0 cm for extrapolation distance
 critical geometry estimated to be 2.4 x 5 x 10 cm.

Base area for building assembly 16 x 18 x 6" thick
 polyethylene.

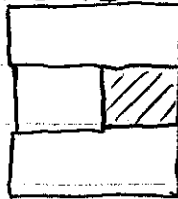


1" ($\frac{3}{8} + \frac{1}{8}$) U Metal 5 x 5

4ea $\frac{1}{4} \times 5 \times 10$

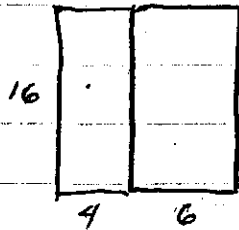
4ea $\frac{1}{4} \times 5 \times 5$

4ea $\frac{1}{4} \times 5 \times 10$



1" ($\frac{3}{8} + \frac{1}{8}$) U 5 x 5

Top Reflector 4" thick



Instrument Check on May 23 Source 10 mCi X

PM-1	Low Trip	OK	Hi Trip	OK
PM-2			Alarm Trip	
IC-1	<u>10 x 10⁻¹²</u>	Meter Trip	OK	Last Trip
IC-2	<u>Amplifier dead</u>	Trip		
IC-3	<u>~ 10⁻¹⁰</u>	Calibration	<u>AW 9m</u>	Redy alarm A trip not hold
IC-4	<u>~ 10⁻¹⁰</u>	Calibration	<u>AW 9m</u>	B " " "
CRM		Meter Trip		C OK

Mult. Curve for ^{polyethylene} reflected Metal System

U Thick	C-1	C-3	IC-1	IC-2	IC-3	IC-4	Tables	
Exp 208	1"	193070	11950	.065 x 10 ⁻¹²	.01 x 10 ⁻¹²	3.2 x 10 ⁻¹³	1.4 x 10 ⁻¹²	Closed
10 ³⁰ AM	1"	192200	7500		Dead			"
	1"	192080	6490		x			"
	1"	185240	6590					Apart
Exp # 209	1 3/4"	165850	6520	.065	n3.	1.3		Apart
11:20	1 3/4"	214260	6610	.065	n3.	1.4		Closed
Exp # 210	2"	386540	7250	.075	n3.5 ⁺	1.5		Closed
11 ^{PM}	2"	387500	7300	"	"	"		"
	2"	163370	6430	.065	3 ⁺	1.4		Apart
#211	2 1/8"	159230	7510	.065	3 ⁺	1.4		Apart
	2 1/8"	X	X	X	X	X		Closed

Table 1.1 Rev Super Crit +

#212 2 3/32 Table Closed Subcrit 1 x 10⁻¹² 2 x 10⁻¹²
 Increase top reflector to 8" added 4 in
 to end of side ^{only} 5" - to 9", (4 sides still 5 in)
 Subcrit and dead -
 extra top reflector upset mult. mes.

Add 1/32 to narrow half. Stack 2 1/8 or 2 7/64
 Fixed 2 3/32 2.109"

#214 Super critical + 393.8 → 3.12 feet } 3.15 ft
 3.19 ft }

182

May 23

Add 4" reflector to top, measure period
 #215 + Period (gained read) $2.90 \rightarrow 63.02 \text{ sec} \rightarrow 13.96 \phi_{th}$ 13.63 feet
 13.804

~4:05 P.M.

216

Add 4" reflector to ends (5" \rightarrow 9")
 + Period. $2.82 \text{ div} \rightarrow 60.84 \text{ sec} \rightarrow 14.31 \phi_{th}$ 13.98 feet
 14.15

May 23

U-Metal $2\frac{1}{8}$ Movable 5×5
 $2\frac{3}{32}$ fixed 5×5

Added reflector on all sides - 6 in on bottom 8" on top
 10" on \odot W side 9 in on E.S.N. sides.

May 24

~11:30

Near Critical System Measurements

	North	South			
	2.129	2.096		1 ea $\frac{7}{8} \times 5 \times 5$	26761
2 $\frac{1}{8}$	.126	2.094	$2\frac{3}{32}$	2 ea $\frac{1}{4}$ (0955, 57)	3834
	.128	2.092		1 ea $\frac{1}{8}$ (1023)	963
	.128	2.094		1 ea $\frac{7}{32}$ (1921)	713
	2.128	2.094			

Avg 2.111 inches

$$\Delta k = +17.2 \phi$$

31.771 kg Metal

PM-1	Low Trip	OK	Hi Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	Motor	OK	Test Trip	
IC-2	amp. Inst. out of service		Bells alarm A - Trip	not held
IC-3	~10 ⁻¹⁰ Calibration	OK	B	OK
IC-4	~10 ⁻¹⁰	OK	C	OK
CRM				

IC-4 Moved to ^{near} under cylinder of movable table Northwest corner of table when closed.

#Exp # 217 ~10⁰⁰ AM + Period +45.3 → 17.43 μ
 17.03 fast
17.23 ϕ Average

Symmetrical $2 \frac{3}{32}$ - $2 \frac{3}{32}$ on both halves.

Exp # 218 Subcritical - my period to short to measure react. (source hole made in $6 \times 6 \times 14$ polyethylene block on Fixed table, so that source ^{tip} is in contact with U metal.)

May 24, 67 Choose 2" of fuel in 4 ea layers

$\frac{1}{4}$ $\frac{1}{4}$

$\frac{1}{2}$ $\frac{1}{2}$

$\frac{1}{2}$ $\frac{1}{2}$

$\frac{1}{2} = 2 \text{ ea } \frac{1}{8}, 2 \text{ ea } \frac{3}{32}, 1 \text{ ea } \frac{1}{16}$ $2 \text{ ea } \frac{1}{8}, 2 \text{ ea } \frac{3}{32}, 1 \text{ ea } \frac{1}{16}$

$\frac{1}{4}$ $\frac{1}{4}$

Initial stack - moderator thickness = $\frac{1}{16}$ in.

Uranium weight	4 ea $\frac{1}{2}$		15333
	4 ea $\frac{1}{4}$		7670
	4 ea $\frac{1}{8}$		3845
	4 ea $\frac{3}{32}$	1950, 51, 12, 21	2856
	2 ea $\frac{1}{16}$		960
			<hr/>
			30,664

EXP # 219 6" Bottom reflector 5" side reflector No Top Reflector.

Subcritical no multiplication

Aligned assembly. added 4" reflector

EXP # 220 on top of each half

Subcritical no multiplication

Completely reflected 6" or greater "polyethylene

47/64 Source hole in reflector

EXP # 221
135

4 ea $\frac{1}{2}$ U metal } $2\frac{1}{4}$ total height.

4 ea $\frac{1}{16}$ Polyethylene

Subcrit. Mult. IC-3

IC-4

$$\frac{1.7 \times 10^{-12}}{.5 \times 10^{-12}} \approx 3.4$$

$$\frac{.85 \times 10^{-12}}{.4 \times 10^{-12}} \approx 2.1$$

Added polyethylene to assembly
 4 ea layers 2ea 0.015 + 1ea 1/16
 Total CH₂ 16ea 0.015
 8ea 1/16

EXP# 222
 2²⁵ PM
 Spheritical IC-3 $\frac{3.3}{0.5} = 6.6$ M
 IC-4 $\frac{1.8}{.45} = 4..$ M

EXP# 223
 4 ea layers 2ea 1/16
 Total 16ea 1/16 x 5 x 5 CH₂ ←
 - Period -1.79

EXP# 224
 3⁵⁵
 Removed Source Hole - placed large Source
 on top for start up.
 @ high Multiplication - Period -1.97 ♀ ←
 Or -1.9 ♀

Size for exp# 223 - 224

N	S
2.484	2.488
4	8
0	4
0	2
2.481	2.485

U-Metal = 30.664 kg Average 2.483
 Polyethylene = 16 x 22.205 = 355.290 g

Instrument Check on May 25 Source 10 mic 8

PM-1	Low Trip	OK	Hi Alarm Trip	
PM-2			Alarm Trip	
IC-1	3x10 ⁻¹⁰	Water Trip	OK	Fast Trip OK
IC-2	Out of Service	Meter Trip		Bldg Alarm A No Trip
IC-3	~ 1x10 ⁻¹⁰			B
IC-4	1x10 ⁻¹⁰	coll bracket	Down OK	C Triggered
CRM		Meter Trip		

CH₂ - Reflected

5 layers
@ 3/8

2 ea	7/32		
1 ea	1/4	1 ea	1/8
1 ea	1/4	1 ea	1/8
4 ea	7/32	4 ea	1/4
4 ea	7/32	4 ea	1/8
2 ea	7/32	24 ea	7/32
			7670
			3845
			17126
			<u>28,641</u> g U

1st assembly with 1/4 CH₂ (no ~~1-12~~ 1-12 exp 6, 8)
 EXP # 225 Super Critical + Period 47.37 or 16.80
 10:00 AM @ 5.1 Rev → 0.27 in.

2nd assembly with 3 ea 1/16 + 2 ea 0.015
 Exp # 226 + Period @ 2.2 Rev → .090 +41.29 sec
 Level @ 2.7 Rev → .117 +18.39
 27 miles
 ~.681 \$/mil

3rd Assembly with 3 ea 1/16 + 1 ea 0.015
 227 A + Period @ 0.8 Rev → .049 $\frac{.188}{15} + 47.81$
 Level @ 1.33 → .043 $\frac{.203}{5} 16.70$
 Separate to ~ 6.0 Rev power decay
 Tables together for pos period meas. $\frac{16.70}{24} = .696$
 ~.69 \$/mil

B + period 0.0 36.57 or 20.04
 level 1.15 → .035

.117 - .043 = $\frac{74}{62}$ miles A.69 = $\frac{44.2}{51.1}$ \$ for change of .015/kgm

Reactivity change for 0.15 layer change
 with 2ea level @ 2.7 or .117"
 1ea @ 1.37 or .043

.074" → 51.1¢ or 5.7¢
 i.e. 10¢ - 0.015

Average worth 0.69¢ per .001"

Excess react = 20.04¢ therefore exp with less
 CH₂ will be ~31¢ subcritical, and cannot
 be measured easily with source available.

System measurements with

5 layers of CH₂ each having 3ea + 1ea 0.015

North	South
2.856	2.862
51	56
44	50
42	50
<hr/>	<hr/>
2.848.25	2.8545
<hr/>	<hr/>
Av 2.851	

Total CH₂ 30 x 22.205 = 666.2
 10 x 5.778 = 57.8

 724.0g
 U = 28641g

96
 98
 2

layer

6 layers $\frac{9}{16}$ ea U

1st assembly with 2 ea $\frac{1}{16}$ + 3 ea 0.015 CH₂

228
2:30 PM

Supererent + period @ 0.87 Rev

14.78 sec 33.27 Th
32.58 Fast
32.93 Av

2nd Assembly with 2 ea $\frac{1}{16}$ + 2 ea 0.015 CH₂

Layer Ord.	}	$\frac{7}{32} + \frac{1}{16}$	4 ea $\frac{1}{4}$	7670
		$\frac{1}{4} + \frac{1}{16}$	4 ea $\frac{1}{8}$	3845
		$\frac{1}{4} + \frac{1}{16}$	12 ea $\frac{3}{32}$	8573
		$\frac{1}{8} + \frac{1}{8} + \frac{1}{16}$	18 ea $\frac{1}{16}$	<u>8640</u>
		2 ea $\frac{7}{32}$ + 2 ea $\frac{1}{16}$		28,728
		2 ea $\frac{3}{32}$ + 2 ea $\frac{1}{16}$	1912, 21, 50, 51, 52, 84, 85	
	$\frac{3}{32} + \frac{1}{16}$	26, 89, 94, 95, 96 = 8573		

Δk =
→ 17.8 φ

CH₂ = 24 ea $\frac{1}{16}$ 24 ea 0.015 = 671.6g

Exp #229

on Pos Period with source inserted /
 Neg Period w.o. " " "

enough Pu in source to add react.
~~→ 30 → 40 φ~~

+ Pos Period → +243.4 Av +4.65
 - Neg Per. -119.5 Av -17.82 ← React

Total 22.47 φ System
 Worth of Pu Source ↑

Measurements

N.	S.
2.804	2.808
$\frac{3}{5}$	12
2	00
	2793


$$\frac{27}{8} =$$

av. 2.803

PM-1	Low Trip	Hi Alarm Trip
PM-2		Alarm Trip
IC-1	3×10^{-11} Meter Trip	Fast Trip
IC-2	Out of Service Meter	Bldg A
IC-3	$> 1 \times 10^{-10}$ Calibration	B
IC-4	$> 1 \times 10^{-10}$ Calibration	C
CRM		

12 layers @ $\frac{5}{32}$ top $\frac{7}{32}$ Bottom $\frac{1}{16}$ 17 126
 $\frac{15}{8} = 1.7\frac{1}{8}$ 480x24 11 520
 Uranium 28 646 g

Exp # 230
 Semi plastic C_{H_2} as previous 6 layer arrangement
 Subcritical
 $IC-3 \quad M = \frac{3 \times 10^{-12}}{4 \times 10^{-13}} = 1.0$
 $IC-4 \quad M = \frac{1.2 \times 10^{-2}}{4 \times 10^{-12}} = 4\frac{1}{4}$

Re stack with 4 layers of C_{H_2} , only, increased by 0.015".
 #231 Subcritical mg per $n-38 \text{ } \phi - 92.3 \text{ sec}$
 moved IC-4 out of PIG to Top of Fixed table.
 moved IC-3 out of "PIG" & close to assembly 

Re stack w 8 layers of C_{H_2} increased by 0.015
 $\left\{ \begin{array}{l} 8 \text{ ea } \frac{1}{16} + 2 \text{ ea } 0.015 \end{array} \right\} 2, 3, 5, 6, 8, 9, 11, 12$
 $\left\{ \begin{array}{l} 4 \text{ ea } \frac{1}{16} + 1 \text{ ea } 0.015 \end{array} \right\} 1 \text{st}, 4 \text{th}, 7 \text{th}, 10 \text{th}$

232 + Period $\rightarrow 22.16 \text{ sec}$ 26.37 Th
 105 PM 26.97 fast
 av. + 26.67

Restack with 1, 3, 5, 7, 9, 11 with sea 0.015 + sea 1/6

246 8 10 12 with sea 0.015 + sea 1/6

0233

Period - just critical (Same as 232
less ten x 5x5 x 0.015)

North South Meas.

~~232 x 23205~~

2.900
900
896
890

2.890
90
93
93

2.8985

2.8915

Av 2.894

231

671.6 g CH₂

232

747.0 g CH₂

233

741.0 g CH₂

28644 g U-Metal

6 layers @ 1/4 in U
 6 layers @ .25 + 2ea 1/16 CHz

1/8
 1/4
 1/4
 1/16 + 2ea 1/32
 1/16 + 2ea 1/32
 1/16 + 2ea 1/32
 1/8

#234

Supercritical + Period
 4.2 Rev @ 0.21 inch separation

Restack with (.25 + 1ea 1/16 + 2ea 0.015) CHz
 in each layer.

Instrument Check on May 30 Source 10mc 8

PM-1	Low Trip	OK	Alarm Trip		
PM-2			Alarm Trip		
IC-1	<i>inst sluggish</i> 3×10^{-10}	Meter Trip	OK	Fast Trip	OK
IC-2	<i>out of service</i>	Meter Trip		Bldg Alarm A	Triggered - not working
IC-3	$\sim 1 \times 10^{-10}$	Calibration	<i>swtch</i>	B	OK
IC-4	$\sim 1 \times 10^{-10}$	Calibration	"	C	OK
CRM		Meter Trip			

4ea 1/4	7670
4ea 1/8	3845
12ea 1/32	8573
6ea 1/16	2880
	22,968

May 30, 1967

EXP # 235

Supercritical @ 1.5 Rev

+ Period +19.12s. 28.9φ

(also Super crit @ 1.9 Rev + Per. 64.76 ^{213.54})

236 Restack with 1ea 0.25, 1ea 1/6 & 1ea 0.015
 + Period (taken together) + 26.51 sec th Av th + 24.1 φ

Measurements

S	3471	N	3459
	69		58
	63		61
	67		62

Av 3.468

1/4 x 5 = 5 CH₂

1, 2, 3, 4, 5, 7

9, 10, 11, 12, 13, 14

12ea 1/6 266.46

12ea 0.015 69.34

Total CH₂

1113.0 g

335.8

1448.8 g

Restack with 1ea 0.25 + 1ea 1/6 + 1ea 0.015 in layer 1, 3, 5

" " 1ea 0.25 + 1ea 1/6 in layer 2, 4, 6.

(i.e. 6pc 0.015 x 5x5 were removed)

S	3418	N	3406
	20		06
	16		10
	21		11

Av 3.415

Total CH₂ = 1414.1 g

237 - Negative period -8.42 ^{div}/_{sec} = -183 = -9.19 > -9.11φ
 -9.03

6ea 0.015 x 5 x 5 = 150

24.1
 21.2 (6.6.4)

May 30

11 layer assembly

CH₂ = 1/4 Fuel 3/32 except bottom 1/32 & top 1/16"

EXP # 238

Sub critical, low multiplier

$\frac{1.3}{1.0}$

$\frac{2.0}{1.0}$

IC = 5

$\frac{2.0}{1.0}$

$\frac{1.0}{1.0}$

5-01

Add a layer, 12 layer assembly.

Fuel 3/32, CH₂ 1/4

EXP 239

2:20 PM

Super critical @ 0.86 rev. + Period

Return to 11 layer assembly 3/32 fuel, 1/4 + 0.015 CH₂

EXP # 240

Subcritical IC = 3 $\frac{3}{1} = 3$

IC = 4 $\frac{2}{1} = 2$

241

11 layer assembly 3/32 fuel, 1/4 + 0.015 CH₂

with source inserted ~ Pos Period

without source - Neg Period ~ 80 sec

Instrument Check on 31 May 67 Source 10 Mc ✓

PM-1 Low Trip OK H1 Alarm Trip OK
 PM-2 Alarm Trip
 IC-1 AMP. SLUGGER ^{3 x 10⁻¹¹} Meter Trip OK Fast Trip OK
 IC-2 10 x 10⁻⁸ Meter Trip OK Bldg Alarm A Flickers
 IC-3 ~1 x 10⁻¹⁰ Calibration OK Swgn B "
 IC-4 ~1 x 10⁻¹⁰ Calibration OK Swgn C "
 CRM Meter Trip

Restacked adding 10pc 0.015 x 5 x 5, in layers 2, 4, 6, 8, 10.

Total CH₂ = 22pc 4 x 5 x 5
 54pc 0.015 x 5 x 5

~~2043.8~~
 312.0

2355.8 g CH₂

2 ea 1/32 480
 2 ea 1/16 960

20 ea 3/32 14 272

15,712 g U metal

Mean	S	N
	4.209	4.210
	208	220
	198	211
	202	207

av = 4.208

Exp # 242 — Period 312.9 4.66
~~393.3 sec~~ ~~3.59~~ fast
-4.75 th
-4.7 φ av

observed a slight misalignment of levels
 of ~~both~~ each half. Realigned table halves.

Exp # 243 ← Period 312.9 4.66 fast
~~393.3~~ ~~3.59~~ th
-3.67
-3.6 φ av
 gained 0.1 φ

18 ea	$\frac{1}{4} \times 5 \times 10$	.265 - .275 av. 270	Total weight 8521.23 av wt	473.30 g
36 ea	$\frac{1}{16} \times 5 \times 10$	.058 - .064 av. .061	Total wt 3880.94 av wt	107.80 g

(10 x 10 base area)

Calculation for volume fraction of 0.5 U - 0.5 - CF₂
 Est. crit. Mass for sphere from other dilution experiments
 increased from 50 to 100 kg U²³⁵

Sphere volume est. from 3.3 x 10 x 10 exp. → 2.975 l
 For 100 kg U²³⁵ at 0.5 vol fract. vol = 2.975 x 4 = 11.90 l

$$R^3 = \frac{11.90}{4.188} = 2.8409 \times 10^3, R = \frac{14.14}{2.1} \text{ cm}$$

$$\tilde{R} = 16.76 \text{ cm}$$

$$B^2 = \frac{11874^2}{4.188} = .03514$$

$$B_1 + B_2^2 = \frac{.02253}{.01261} \approx 11.225 \approx 10''$$

$$5'' \times 10'' \times 10'' \rightarrow 5 \times 30.6 = \approx 153 \text{ kg}$$

$$\frac{5''}{7/8} = \frac{40}{7} = 6 \text{ layers @ } 7/8 = \frac{42}{8} = 5 \frac{1}{4}'' \text{ uranium}$$

~~Therefore start with~~
~~Flow = 2 ea x 1/4 + 6 ea x 3/16~~
~~3 layers~~

Arbitrarily choose 6 layer arrangement with
 $1\frac{1}{32}$ layers of U metal and $3 \times \frac{1}{16}$ layers of CF_2

Instrument Check on June 1 Source 10 mc X

PM-1	Low Trip	OK	H _i Trip	OK
PM-2			Alarm Trip	
IC-1	<u>Out of Service</u>	Meter Trip	Fast Trip	
IC-2		Meter Trip	OK	Blg Alarm A Trip not held
IC-3	$\sim 3 \times 10^{-11}$	Calibration		B " " "
IC-4	8×10^{-11}	Calibration		C OK
CRM		Meter Trip		

Count 1st Assembly $3\frac{1}{2}$ U layers + 3 CF_2 layers

Source	$5' C_2$	10830	, 10610	10080
inserted	$5' C_3$	8500	, 8600	7910
EXP # 244	IC-2	$.06 \times 3 \times 10^{-11}$		.055
	3	4×10^{-13}		3.5
	4	7×10^{-13}		6.5
	Tables Closed			Apart

2nd Ass. $5\frac{1}{2}$ U layers + 5 CF_2 layers ($\frac{3}{32}$ missing from 3rd layer)

# 245	C_2	17740	12380
	C_3	14330	9200
	IC2	$.10 \times 3 \times 10^{-11}$	.06
	3	9.5×10^{-13}	5
	4	1.8×10^{-12}	9

Big crack!

246 3rd assembly 6 layers @ $1\frac{1}{32}$ U and $\frac{3}{16}$ CF₂
 Top U = $\frac{1}{4}$ Bottom U = $\frac{1}{4} + \frac{3}{32}$
 Subcritical ~ Some Mull 720

Straiten & Align at 3" separation T=75°F

Add $\frac{1}{16} \times 4 \times 10 \frac{3}{4}$ Al on North & South.

247 + Period + 561.5 + 2.29¢

Mass N	S
4.631	4.684
86	703
90	684
86	694

av 4.688

248 Remove $\frac{1}{16} \times 4 \times 5 \frac{7}{8}$ Al on South Fixed Table
 - Period - 265.1 sec - 5.66¢

Total worth of Alum = 7.95¢

React. of Bare ass. = + 2.29 - 8 x 7.95

= -61.3¢

4ea $\frac{1}{2} \times 5 \times 5$	7670	CF ₂ 36 parts
Monium 2ea $\frac{1}{2} \times 5 \times 10$	15314	
2ea $\frac{1}{2} \times \begin{cases} 3 \times 10 \\ 2 \times 10 \end{cases}$	15335	= <u>3821.9</u>
4ea $\frac{1}{2} \times 5 \times 5$	15333	
24ea $\frac{1}{32} \times 5 \times 5$	17126	
2ea $\frac{1}{4} \times 5 \times 10$	7631	
4ea $\frac{1}{8} \times \begin{cases} 3 \times 10 \\ 2 \times 10 \end{cases}$	7706	
2ea $\frac{1}{4} \times \begin{cases} 3 \times 10 \\ 2 \times 10 \end{cases}$	7665	
8ea $\frac{1}{8} \times 5 \times 10$	15354	
109 189 g U-metal		

6 layer arrangement @ $\frac{1}{8}$ 0.5 CF₂

$$\frac{5}{16} \quad \frac{1}{4} \times 5 \times 5 \quad \frac{1}{16} \times 5 \times 5$$

$$0.27 + 4ea.060 \quad CF_2$$

$$\frac{5}{8} \quad \frac{1}{2} \times 5 \times 10 \quad \frac{1}{8} \times 5 \times 5$$

$$2ea. 0.27 \quad CF_2$$

$$\frac{5}{5} \quad 1ea. \frac{1}{2} \left(\begin{matrix} 3 \times 10 \\ 2 \times 10 \end{matrix} \right) \quad \left(2ea. \frac{1}{16} \times 5 \times 5 \right) \rightarrow \left(\frac{1}{8} \times \begin{matrix} 3 \times 10 \\ 2 \times 10 \end{matrix} \right) \quad \times 2$$

$$0.27 + 4ea.06 \quad CF_2$$

$$\frac{5}{5} \quad 2ea. \frac{1}{2} \times 5 \times 5 \quad \left(2ea. \frac{1}{16} \times 5 \times 5 \right) \rightarrow \left(\begin{matrix} 3 \times 10 \\ 2 \times 10 \end{matrix} \right) \quad \times 2$$

$$2ea. 0.27 \quad CF_2$$

$$\frac{5}{8} \quad 5ea. \frac{1}{8} \times 5 \times 10 \quad \times 2$$

$$0.27 + 4ea.06 \quad CF_2$$

$$\frac{5}{8} \quad \frac{1}{4} \left(\begin{matrix} 3 \times 10 \\ 2 \times 10 \end{matrix} \right) \quad 2ea. \frac{1}{16} \times 5 \times 5 \quad \times 2$$

$$2ea. 0.27 \quad CF_2 \quad 1-09$$

$$\frac{5}{16} \quad \frac{1}{4} \times 5 \times 10 \quad 2ea. \frac{1}{16} \times 5 \times 5 \quad \times 2 \quad 0-01$$

1st assembly 4 1/2 layers only

#249 Only slight multiplication on sec-2, 3 & 4

$$c_2 \quad 13110$$

$$c_3 \quad 10270$$

2nd assembly 6 layers

#250 Subcritical — Mult w/4 (IC-3)

Removed 1ea $\frac{1}{16} \times 5 \times 10$ from 2, 4, 6 layers

Change 2ea $\frac{1}{16} \times 5 \times 5$ for 1ea $\frac{1}{8} \times \frac{3 \times 10}{2 \times 10}$ in layer 4
" " " " " " layer 5

Exp #251 Subcritical Mult ~ 4 (IC-3)

Restacked with 1ea 0.27 and 2ea 0.06 in CF₂ in each layer

Exp 252
4:00pm
June 1, 67

1ea 0.27 M ~ 10 (IC-3)

15314
14197
12325
700
3345 1/2
99.856
15.235
114.171

Restacked w. 1ea to and 1ea 0.27 in top 3 layers.

Exp # 253 Subcrit M ~ 20 (IC-3)

Instrument Check on JUNE 2, 67 Source 10mc⁸

PM-1	Low Trip	OK	Hi Alarm Trip	OK
PM-2			Alarm Trip	
IC-1	<u>Out of Service</u> Meter Trip		Fast Trip	
IC-2	<u>10 x 10⁻¹¹</u> Meter Trip	OK	Bldg alarm A Trip	not held
IC-3	<u>> 10⁻¹⁰</u> Calibration	OK <u>swt</u>	B	OK
IC-4	<u>> 10⁻¹⁰</u> Calibration	"	C	OK
CRM	Meter Trip			

Source Response OK

Restacked assembly with 1ea 0.270 and 1ea 0.060 in each layer

Exp 254 + Period 205.3 sec + 5.33

(System gap is excessive?)

Add 1/16 x 4 x 5 3/8 Al. to South east corner.

255 + Period 173.01 sec + 12.25

Alum worth (255 - 254) = 6.92

Straighten assembly with 3" □ tubing, remove Al.

256 + Period 41.72 + 18.05 φ

gap Reduced and gained react.

Straighten ass. with 3" □ tubing, No Al. on Top!!

257 + Period 36.94 sec + 19.51

12.5 @ 473.3

12.5 @ 107.4

12 x 571.1 = 6763.2 g CF₂

11.11 kg U

North South

React. = 19.51 - 4 x 6.92

5.776 5.812

70 793

67 802

84 824

27.68

$\Delta R = -8.17$ (bare ass)

5.774 5.808

808

5.791 av

6 layers @ $21/32 = 126/32 = 3.9375''$ fuel

$$\frac{1}{4} + \frac{1}{16} = \frac{5}{16} = \frac{10}{32} \qquad \frac{1}{4} \times \frac{3 \times 10}{2 \times 10} \qquad \frac{1}{16}$$

$$\frac{1}{2} + \frac{3}{32} + \frac{1}{16} \qquad - \qquad \frac{1}{2} \times 5 \times 10 \qquad \frac{3}{32} + \frac{1}{16}$$

$$\frac{1}{2} + \frac{3}{32} + \frac{1}{16} \qquad \frac{1}{2} \times \frac{3 \times 10}{2 \times 10} \qquad \frac{3}{32} + \frac{1}{16}$$

$$\frac{1}{2} + \frac{3}{32} + \frac{1}{16} \qquad \frac{1}{2} + \frac{3}{32} + \frac{1}{16}$$

$$\frac{1}{4} + \frac{1}{8} + \frac{1}{8} + \frac{3}{32} + \frac{1}{16} \qquad \frac{1}{8} + \frac{1}{8} \times \frac{3 \times 10}{2 \times 10} \qquad \frac{1}{4} + \frac{3}{32} + \frac{1}{16}$$

$$\frac{1}{4} + \frac{1}{8} + \frac{1}{8} + \frac{3}{32} + \frac{1}{16} \qquad \left(\frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8}\right) \times 5 \times 10 \qquad \frac{1}{4} + \frac{3}{32} + \frac{1}{16}$$

$$\frac{1}{4} + \frac{3}{32} \qquad \frac{1}{4} \times 5 \times 10 \qquad \frac{3}{32}$$

Total 120,709 kg U

June 2 ~ 10⁴⁵ AM

10.460 kg CF₂

1st assembly stacked with 1ea 0.27 ϕ 3ea 0.06 CF₂ in each layer

EXP# 258

+ Period @ 5.4 Revolution - assembly not in alignment, + 89.64 ea + 10.50 ϕ

separate to 25.4 \rightarrow back to 5.0

259

+ Period + 10.87 ea \approx 37.7 ϕ very fast.

Restack with layers 2, 4, 6 changed to 2ea \times 0.27 CF₂

(1, 3, 5) have 1ea \times 0.27 + 3ea 0.06 CF₂

Total CF₂ 18ea @ 0.27 + 18ea 0.06 = 871.7g
 8519.4 + 1.940.4 = 10459.8

11³⁵ AM June 2, 1967 high Mult ≈ 30
 EXP # 260 Subcritical - with gap

North half appears $\approx \frac{1}{6}$ shorter than
 South half.

With tubes separated $\frac{3}{8}$ ", align assembly
 interchange top layers, add alum on
 top of North and South.

EXP # 261 + Period + 329.6 + 3.50

Remove $\frac{1}{10} \times 4 \times 5 \frac{3}{8}$ Al

EXP # 262 - Neg Period -1000, -1.33 ϕ

Al worth 4.83

EXP # 261 has Al on both top and bottom

$$+3.50 - 8 \times 4.83 =$$

$$38.64$$

$$\underline{35}$$

$$\Delta k(\text{bare}) = -35.14 \phi$$

10.46 kg CF_2

87.6 kg CF_2

120.709 kg U

Meas

North

South

7.000

6.996

6.996

6.999

6.965

7.003

7.004

av 6.996

35

8

5x10 x $\frac{1}{16}$ Plexiglass weights

1	48.04		31	59.93	1603.60
2	50.04	98.08	32	59.80	1663.40
3	48.60	146.68	33	57.29	1720.69
4	52.51	199.19	34	58.50	1779.19
5	48.80	248.09	35	59.89	1839.08
6	50.43	298.52	36	54.82	1893.90
7	49.05	347.57	37	58.77	1952.67
8	49.14	396.71	38	56.90	2009.59
9	48.41	445.12	39	56.94	2066.51
10	47.31	492.43	40	57.87	2124.38
11	49.80	542.23	41	57.26	2181.64
12	49.45	591.68	42	56.45	2238.09
13	48.52	640.20	43	53.78	2291.87
14	47.46	687.66	44	59.55	2351.42
15	48.28	735.94	45	54.78	2406.20
16	50.93	786.87	46	58.01	2464.21
17	50.25	837.12	47	58.98	2523.19
18	50.14	887.26	48	55.18	2578.37
19	52.76	940.02	49	57.82	2636.19
20	52.62	992.64	50	56.02	2692.21
21	54.16	1046.80			
22	51.21	1098.01			
23	56.76	1154.77			
24	51.91	1206.68			
25	52.96	1259.64			
26	52.66	1312.30	48		
27	55.88	1368.12	141	60.75	
28	55.70	1423.82	142	68.91	
29	61.71	1485.53	143	64.90	
30	58.14	1543.67	144	67.25	
			145	62.90	
			146	62.39	
				581	

1/4" x 5 x 10 Plexiglass weights

234	1	226.43		250	31	226.43		
235	2	226.00	452.43	250	32	226.00	241.77	7511.28
	3	229.20	681.63	252	33	229.20	243.52	*
	4	226.13	907.76	"	34	226.13	244.08	7755.36
	5	228.46	1136.22	4	35	228.46	245.24	8000.60
238	31	231.07	1367.29					
238	6	231.27	1598.56	"	36		244.50	8245.10
	7	232.65	1831.21	"	37		244.78	8489.88
240	8	232.88	2064.09	256	38		247.38	8737.26
	9	233.26	2297.35		39		247.72	8984.98
	10	232.68	2530.03		40		250.42	9235.40
	11	231.68	2761.71					
	12	231.73	2993.44		41		247.75	9493.15
241	13	234.18	3227.62					
	14	235.02	3462.64					
	15	236.20	3698.84					
242	16	234.10	3932.94					
243	17	234.33	4167.27					
	18	234.61	4401.88					
244	19	237.84	4639.72					
	20	236.77	4876.49					
	21	235.00	5111.49					
245	22	237.78	5349.27					
"	23	237.07	5586.34					
"	24	236.77	5823.11					
247	25	239.86	6062.97					
	26	238.62	6301.59					
250	27	242.34	6543.93					
	28	241.19	6785.12					
	29	241.73	7026.85					
"	30	242.71	7269.56					

Instrument Check on June 5 Source 10mc ✓

M-1	Low Trip	Alarm Trip
M-2		Alarm Trip
C-	Meter Trip	Fast Trip
IC-2 10×10^{-11}	Meter Trip <u>OK</u>	A No Trips B Held
IC-3	Calibration <u>OK Dewa</u>	C Held
IC-4	Calibration <u>OK</u>	
CRM	Meter Trip	

after checks - set trips down to OK

June 5, 1967

6 layer U @ $\frac{1}{2}$ " = 3.00 Plexiglass @ $\frac{1}{4}$ " (poly-ethylene was
crit with #16)

1st assembly with $\frac{1}{4}$ " Plexiglass

Tables	C ₂	C ₃	IC-2	3	4
2 $\frac{1}{2}$ U 2 Plexiglass	9610	8160	$.02 \times 10 \times 10^{-11}$	4.4×10^{-13}	7.5×10^{-13}
EXPE #263	8330	8230			
Apert	9030	7950			
4 $\frac{1}{2}$ U 4 Plex	10140	8690	$.02^+$	4.7	8.5
#264	11500	18360?	.03	6	1.0
	11390	4680			
6 U 6 Plex	12420	9920	.025	0.65×10^{-12}	1.1×10^{-12}
#265	56570	53710	.105	5×10^{-12}	6.2×10^{-12}

Mult ~ 5 - 8

2nd Assembly with ($\frac{1}{4}$ + $\frac{1}{16}$) Plexiglass each layer $\frac{1}{4}$ (Nos 1-11, 31) 2761.7 $\frac{1}{16}$ (Nos 1-12) 591.7

3353.7 g Plex

#266 Spherical Tables @ 1.7

+ Period + 18.14 sec → + 29.36¢

3rd Ass with 12ea $\frac{1}{4}$ Plex 2761.76ea $\frac{1}{16}$ " 298.5

3060.2 g Plex

#267

Spherical Mult ~ 10+

7K

	5x10	3x10 2x10	5x5	
$\frac{1}{4}$			$\frac{1}{4}$	$\frac{33}{7670}$
$\frac{1}{2}$	$\frac{1}{2}$			15319
$\frac{1}{2}$		$\frac{1}{2}$		15335
$\frac{1}{2}$			$\frac{1}{2}$	15333
$\frac{1}{2}$		$\frac{1}{4} + \frac{1}{8} + \frac{1}{8}$		15371
$\frac{1}{2}$	$\frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8}$			15354
$\frac{1}{4}$	$\frac{1}{4}$			<u>7681</u>
				92063 g v

268 Plex 382.10 Thickest in pcs
2761.7
 Inherit 3148.8

N. Ct ~ 20

#269 4×10 [No 28-41 inc 31, 33] = 2939.22
277.10
 Plex glass 3826.32

Restricted selection, thickest and heaviest

$\frac{1}{4}$ " pcs of Plexiglass

Inherit @ 3.5 Rev + Period + 102.78 + 9.45g

Restricted with $\frac{1}{16}$ No 1-6 2939.22
298.5
 3237.7

#270 ~~together~~
 + Period + 71.495pc + 12.44¢

Straighten assembly - level and align holes

#271 Pop Per Tabs @ 3.5 +24.55 \xrightarrow{sec} +24.90¢
 Gap very small by appearance!

June 5, 1967

Rechecked with $\frac{1}{10}$ No 20 - 32 (4c 31) 2371.56
 (Total 67.6g) $\frac{1}{10}$ No 1-6 in all layers 293.5
 (1, 3, 5)
 U = 92,063. 317.1

#272

+ Period \rightarrow + 245.6 ac + 4.56¢

add $\frac{1}{6}$ 4 x 5 $\frac{3}{8}$ Alum on South east

#273

+ Period \rightarrow + 61.50 ac + 13.87¢

PIX

Alum \rightarrow 9.31¢

$$\Delta k = \frac{37.24}{+4.56 - 4(9.31)} = -32.7¢$$

Bare Assembly

Measurements.

North South

4.662	4.648
54	73
46	75
<u>55</u>	<u>52</u>
54	62

Av 4.658

ave
¢

5 layers @ 1/2 V

	5x10	3x10 2x10	5x5	
1/4			1/4	7670
1/2	1/2			15319
1/2		1/2		15335
1/2			1/2	15333
1/2	1/8 + 1/8 + 1/8 + 1/8			15354
1/4	1/4			7681
				76612

1st assembly 2 ea 1/4 x 5 x 10 Plexiglass each layer (1-19, 31)
1 ea 1/6 x 5 x 10 " " " (1-10)

Instrument Check on 6-6-67 Source 10mc X

PM-1	Low Trip	Hi Alarm Trip
PM-2		Alarm Trip
IC-1	<u>Out of Service</u> Meter Trip	Fast Trip
IC-2	Meter Trip <u>OK</u>	<u>Bldg Alarm</u> A - No Trip
IC-3	Calibration	B - OK
IC-4	Calibration	C - OK
CRM	Meter Trip	

Stacked 2 1/2 layers U 2 plex. Aligned top of U to be level. Separated and completed stack layers

Exp # 274

Subcrit Mult ~ 3

	C2	C3	IC3	4
closed	26110	24900	1.9 x 10 ⁻¹²	3.2 x 10 ⁻¹²
apart	12040	9700	.5	1.7

Add Nos 11-20 1/6 x 5 x 10 (~ 500 g)

224

Total plastic $\frac{1}{4}$ No (1-19,31) 4639.72

$\frac{1}{16}$ No (1-20) 992.64

5632.4 g

EXP # 275	C-2	C-3	IC-3	IC-4
Subcrit	37650	36920	2.8	4.5

Add 10m $\frac{1}{16}$ (Nos 21-30) 4639.72

1543.67

6183.4

Exp # 276 Subcritical
- Period

Strap on Assembly @ 3" sep

Add Alum on top N & S

EXP # 277 + Period (0.0) + 8170 sec + 11.27 ϕ

Remove Alum on South east

EXP # 278 + Period (0.0 sec) + 172.1 sec \rightarrow + 6.20 ϕ

Al worth 5.07 ϕ

$\frac{\times 8}{40.56}$

Bare React # 277 = +11.27 - 40.56 = -29.29 ϕ

Masa	S	N
	5.700	5.687
	40	707
	10	719
	45	701
	<hr/>	<hr/>
	5.724	5.704

6.1834 kg Plex

76.692 kg U metal

or 5.714

$\frac{1}{4}$ " U 8 layer arrangement
2.00" V total

	5x10	3x10 2x10	5x5		543
$\frac{1}{8}$			$\frac{1}{8}$		3845
$\frac{1}{4}$	$\frac{1}{4}$				7681
$\frac{1}{4}$		$\frac{1}{4}$			7665
$\frac{1}{4}$			$\frac{1}{4}$		7670
$\frac{1}{4}$		$\frac{1}{8} + \frac{1}{8}$			7706
$\frac{1}{4}$			$\frac{1}{32} + \frac{3}{32} + \frac{1}{16}$	1412 21 57 57 489	1920 5719
$\frac{1}{4}$	$\frac{1}{8} + \frac{1}{8}$			1952 84 85 86	19197
$\frac{1}{4}$	$\frac{1}{8} + \frac{1}{8}$				61403
$\frac{1}{4}$	$\frac{1}{8} + \frac{1}{8}$				
$\frac{1}{8}$	$\frac{1}{8}$				

Estimated 9000g Plex for 6.04kg
or 2ea $\frac{1}{4}$ & 3ea $\frac{1}{8}$

Assembled 4 $\frac{1}{2}$ " U 4 Plex - Aligned with Tables together

EXP # 279

8 layers U, 8 Plex

+ Post Period with gap visible (0.0 Rev) +58.24 sec + 14.41 ϕ

Instrument Check on June 7 Source 10 mc X

PM-1	Low Trip	Hi	Alarm Trip
PM-2			Alarm Trip
IC-1	Out of Service Meter Trip		Fast Trip
IC-2	Meter Trip		
IC-3	Calibration		
IC-4	Calibration		
CRM	Meter Trip		

228

June 7, 1967

Exp # 280

Repeat of 279

+ Period ~~18~~ 55.41 sec
14.92 ϕ

Exp # 281

Add $\frac{1}{16} \times 4 \times 5\frac{3}{8}$ all To ~~North~~ Southeast

+ Period ~~40.0 sec~~ 40.0 sec
~~18.54 ϕ~~ 18.54 ϕ

Allow worth 3.62 ϕ

Exp # 282

align Straighten Assembly with 3" al Boxes

+ Period 29.34 sec assembly has small gap
22.46 ϕ

Exp # 283

align and straighten again

good Stack

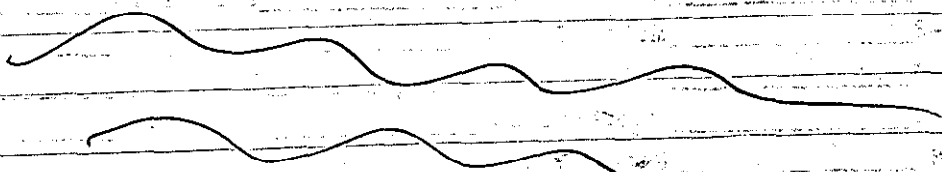
PIX

+ Period 13.9 sec
→ + 33.58 ϕ

React of Bare Ass. 14.48

$\Delta k = + 33.58 - 4 \times 3.62$

$\Delta k = + 19.1 \phi$



Plexiglass 2ea 1/4
[1-32]
~~1-32~~

3ea 3/4
Nos 1-48

Meas.

7511.28

2578.37

N 7.235 S 7.255

2578.37

23 50

10089.65 g Plexiglass

32 50

40 53

7.235 7.252

252

av 7.242

June 7

284 Staked 5 layer @ $\frac{5}{8}$ U with 4 ea $\frac{1}{16}$ Nos 9-48
Subcrit. w. gap

285 Straighten Assembly
Subcrit w. gap

~~# 286~~ Staked 5 layer @ $\frac{5}{8}$ with 4 ea $\frac{1}{16}$ No 15-48

387.10
1890.71

Nos 141-146

2277.81 g Plexiglass

	5x10	3x10 2x10	5x5	
$\frac{5}{16}$		$\frac{1}{4}$	$\frac{1}{16}$	8x60 = 533 3840
$\frac{5}{8}$	$\frac{1}{2}$	-	$\frac{1}{8}$	$\frac{1}{2}$ { 3845 7706 15354
$\frac{5}{2}$		$\frac{1}{2}$		{ 7265 7681
$\frac{1}{2}$		$\frac{1}{8}$	$\frac{1}{2}$	{ 15333 15335 15319
$\frac{5}{8}$	$\frac{1}{8} + \frac{1}{8} + \frac{1}{8} + \frac{1}{8}$			92078
$\frac{5}{16}$	$\frac{1}{4}$		$\frac{1}{16}$	3843
				95921

286 Subcrit w. small gap
Measurable period if at higher power.

Shut down to straighten and add alpha

287 above $\frac{1}{16} \times 4 \times 5 \frac{7}{8}$ Al plate
Minimum gap
+ Period +156.0 sec \rightarrow 6.73 ϕ

232

288

Remove Alum

Negative Period - 617.0 sec - 2.20 ϕ

Alum Worth 8.93 ϕ

Bare Assembly

$$\Delta k = -2.20 - 17.86 = -20.06 \phi$$

Meas.

N 4.345	S, 4.320
41	14
17	27
15	33

4.3295 4.3285

av 4.329

4 layer @ $13/16 = 3.25 \text{ in}$

	5x10	$\frac{3 \times 10}{2 \times 10}$	5x5		434
$17/32$		$\frac{1}{4}$	$\frac{1}{16} + \frac{3}{32}$		15319 15335 15333 15354 7706
$13/16$	$\frac{1}{2} + \frac{1}{8} + \frac{1}{8}$		$\frac{1}{16}$		7081 7665
$13/16$		$\frac{1}{2} + \frac{1}{8} + \frac{1}{8}$	$\frac{1}{16}$		5774
$13/16$	$\frac{1}{8} + \frac{1}{8}$		$\frac{1}{2} + \frac{1}{16}$		3682
$13/32$	$\frac{1}{4}$		$\frac{1}{16} + \frac{3}{32}$		4971

Instrument Check on June 8 Source 10 mc

PM-1	Low Trip	OK	Alarm Trip	OK	
PM-2			Alarm Trip		
IC-1	10 x 15"	Meter Trip	OK	Fast Trip	OK
IC-2	10 x 10"	Meter Trip	OK	Bldg Alarm A	Flicker
IC-3		Calibration		B	OK
IC-4		Calibration		C	OK
CRM		Meter Trip			

1st assembly with 3in $1/16$ 5x10 Nos 1-24 = 1206.7g

Exp 289 Sub crit Mult ~10
alignment not good!

Exp 290 leveled both halves and aligned gap with
3" \square alum tubing. Added $\frac{1}{16} \times 4 \times 70 \frac{3}{4}$ Alum
on South.

Sub crit Mult ~10
(Not much gained!)

Restack with thicker plastic layers Nos 25-48 = 1371.7g
(inc of 170 g)

#291 Subcrit mult $\sim 20-30$
Small gap

#292 Straighten assembly add alum on north and South
Super crit Tube @ 3.2 (only small gap)
+ Period ~ 26.0 sec

Remove al from North $\frac{1}{16} \times 4 \times 10^{3/4}$.
(al remains on South $\frac{1}{16} \times 4 \times 10^{3/4}$)

#293 + Period 790.0 sec \rightarrow + 10.47 ϕ

Remove al from South west
(al $\frac{1}{16} \times 4 \times 5^{3/8}$ remains on South east)

#294 ∞ Period

Mass			
S	3.999	N	4.002
	97		3.998
	85		84
	89		82
	<u>3.9925</u>		<u>3.9915</u>
			av 3.992

React of Bare Assembly

$$\begin{aligned}\Delta k &= -5 \times 10.47 \\ &= -52.35 \text{ \textcircled{f}}\end{aligned}$$

FINIS

July 31, 1968

on Friday Jere Nichols and A. O'Callahan agreed that "we" could measure the thermal flux in the vicinity of a ²⁵²Cf source for him.

Discussions with him and Haynes from the TRL has revealed that the source has been estimated

to be 8.0×10^8 n/sec.

reported to be 544 ± 10 μg of ²⁵²Cf $\times 2.34 \times 10^2 = 1.29 \times 10^9$ n/sec (J.N. Aug 3, 68)

has 20 α per Spm fission, (John Bigler coll.)

α activation
exp indicated
340 μg

Original size of source was 2×10^7 so over the week end of July 26-29, ^{65hr} I irradiated a 1" square of 10 mil copper foil approx 1cm from the north 1" x 5" long Pa Be source 7×10^6 n/sec.

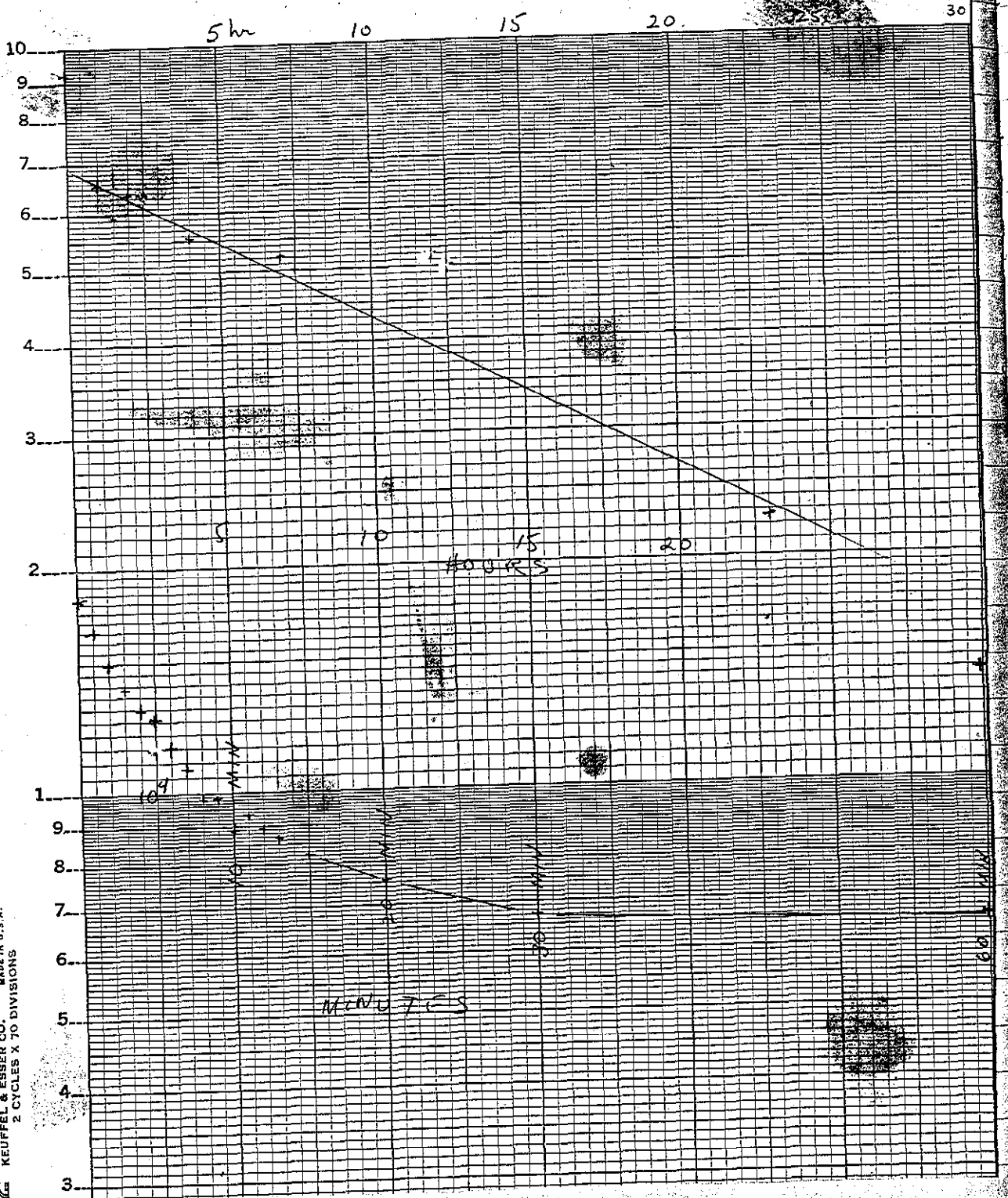
This irradiation gave 97% of Saturation the decay was observed by John Westbrook in the Health Physics β - δ counter at 10% geom. which supposedly counts everything above 0.3 MeV. 10% geom for end window GM tube determined with ¹³⁷Cs source. Normalization is a problem!


From J. Nichols calculations Thermal flux per neutron

is	cm	Flux	Transformed Lid Tank	per J.N.
0		0.0136		
1		137		
2		131		
3		120		
4		105		
6		0.00748		
8		482		
10		291	2.00220	15 $\rightarrow 6.38 \times 10^4$
20			.000197	
30			.0000191	

Decay Time	Dis. Rate (B, S)	
8 ³⁵ 7-29-68 0	18,190	12.8 hr Sat act ~ 6900 dis MIN
1 min	16,530	
2	14,900	
3	13,840	
4	12,950	
5	12,580	
6	11,470	
7	10,780	
8	9,810	
9	9,810	
10	8,870	
11	9,300	
12	8,910	
13	8,620	
15	8,210	
20	7,550	
30	6,720	
60	6,510	
2 hr	6,360	
4	5,340, 5,730	
7	5,280, 5,130	
7 1/2	4,960, 4,930, 5,320, 4,830	
23	2,260 (av of 3)	
(2 ³⁵ July) 30	12,900, 13,400, 15,500	

m/acc
(68)
v calc
m/acc
M. 22




 SEMI-LOGARITHMIC 358-61
 KEUFFEL & ESSER CO. MADE IN U.S.A.
 2 CYCLES X 10 DIVISIONS

30

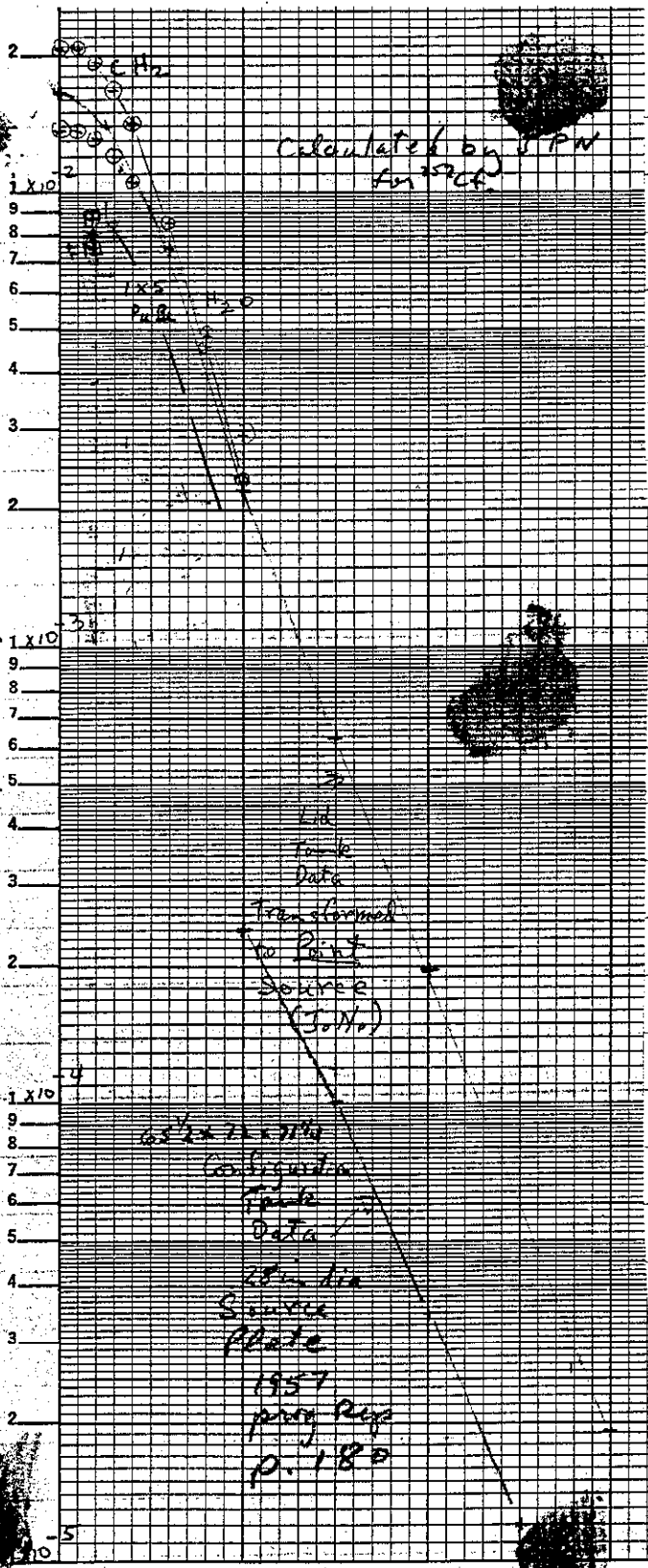
2 foil
10 foil

Source
Radius
= 1.27 cm

SEMI-LOGARITHMIC
KEUFFEL & ESSER CO.
4 CYCLES X 70 DIVISIONS
MADE IN U.S.A.
359-81G

μ Neutrons/cm²/sec / foils neutrons

Calculated by J.P.W.
for 1957



Transformed
to Point
Source
(J.P.W.)

Configuration
Tank
Data

1000 cc
Source
Plate
1957
prog Rep
P. 180

10 20 30
4" cm 18" 12"

July 31 10:00 AM Started irradiation of 16 ea 1" square Cu foils (10mic) for checking out 3" x 3" NaI - Scintillator with Cu. Foils in double layer 2" x 4" ~1cm from 1" x 5" Source 7×10^6 n/sec. M - 226

48" O.D. x 48" high Tank, formerly used to extend "Little Bell" for some special UF₆ exp, is available. A slot for a cadmium safety, curved, must be removed. Traverse can be made up to 50-60 cm from source

Aug 1 9:00 AM removed 2 foils from central group of 8.

	X		

3x3 XTL @ 10.50v TMC @ 64 x 0.75 0.511 Mev in Ch. 85?
 $\rightarrow 1 - e^{-.95} = .05$

Counting Time 3600 sec Source Dist 2cm

Decay Time 20' ~~neglected~~ $\rightarrow .98$

Irrad. Time 23 hr $1 - e^{-.712} \rightarrow .712$

Area under peak 205,060 counts $.98 \times .712 \times .05$
~~ply neglected~~ $= .0349$

Peak/total eff 0.625 } @ 511
 Total eff 0.155 } .0969

Total weight ~ 2.90 g

205,060 cts/hr Bkg (Est) $3/60 = 201,900$
 $\times \frac{1}{2.93} = 69,986 \text{ cts/hr g}$
 $\times \frac{1}{8000} = 19.44 \text{ cts/sec g}$
 $\times \frac{1}{.625 \times 1.55} = 200.6 \text{ Dis/sec g}$
 $\quad \quad \quad \underline{.0929}$

Decay time $1\frac{2}{3}$ hr
 Count time $3\frac{1}{2}$ hr $144,471 - \text{Bkg} = 133,500$
 Source Distance 8 cm Total Eff .031
 Peak/total .645 } .0200

$e^{-\lambda t_d} = e^{-.643 \times .1302} = .9108$
 $1 - e^{-\lambda t_c} = 1 - e^{-.643 \times .273} = 1 - .83 = .17$

$\quad \quad \quad \underline{.712}$
 $.9108 \times .17 \times .712 = .1111$
 $S.A = \frac{\text{Counts } \lambda}{(1 - e^{-\lambda t_c})(1 - e^{-\lambda t_d})(e^{-\lambda t_d})}$

2 cm	8 cm
$201,900 \times 1.504 \times 10^{-5}$	$133,500 \times 1.504 \times 10^{-5}$
$= 3.037$	$= 2.002$
$\times \frac{1}{.0969} = 31.34$	$\times \frac{1}{.02} = 100.1$
$\times \frac{1}{.0349} = 898$	$\times \frac{1}{.1111} = 901$

or $899.5 \times \frac{1}{2.9} = 311.2 \text{ Dis/sec g}$

Foil wt ~ 2.9 $p^+ 19\% \times \frac{1}{1.4} \rightarrow 1638$
 $G.N = \frac{4.4 \times 10^{-24} \times 19 \times .69 \left(\frac{6.8}{1.4}\right) \times .6024 \times 10^{24}}{63} = \frac{.02903}{.02517}$

$$\frac{1638}{.02903} = 5.642 \times 10^4 \text{ n/sec cm}^2$$

$$\frac{x}{7 \times 10^6} = 0.773 \times 10^{-2} \text{ flux/feet neut}$$

$$x \cdot 1.13 = .8735 \times 10^2$$

Aug 2, 68 1⁰⁰ PM Removed remaining 14 foil

$$\begin{aligned} & \times 1.13 \\ & = 412 \end{aligned}$$

2³⁰ PM Start count of 10 foils @ 8 cm distance

Irradiation Time 5 hr / 12.8 = 3.984, $e^{-x} = .0635$, $1 - e^{-x} = .9365$

Decay time 1.5 hr / 12.8 = .117, $e^{-x} = .92$

Count time 1 hr / 12.8 = .078, $\times .073 = .0541$

Total Counts 238740 [90-62]

Bkg 3698 [90-62]

235042

$$\begin{aligned} 1 - e^{-x} &= .0541 \\ \frac{x^2}{2} &= \frac{.0015}{.0526} \end{aligned}$$

$$S.A. = \frac{2.35 \times 10^5 \times 1.504 \times 10^{-5}}{.9365 \times .92 \times .0526} = 78,000$$

Eff = .0200

S.A. = 3900

fract β^+ $\times \frac{1}{.19} = 20526$

10 foils $\times 1.45 = 14.54 \text{ g} \rightarrow 14162 \text{ dis/g sec}$

$\Sigma = 5 N = .02903 \rightarrow 4.878 \times 10^4 \text{ neutrons/cm}^2 \text{ sec}$

$$\frac{x}{7.8 \times 10^6} = 0.668 \times 10^{-2}$$

uncorrected for pt abs in
10 upper foils ~ .1" thick
.25 cm, 2.2 g/cm²

Ar over May $\frac{1}{.886} = 1.13$ 0.753×10^2

Aug 8, 68 10' count Cs A 112-82 = 90486 Baseline @ 1.06
 10' count Cs B 112-82 = 93591 LA 64 x 1.0 short Pulse
 10' Bkg 112-82 = 619 Cs Peak at Ch 98

Live time counting

Peak A = 89867 / 10' = 149.78 cts/sec
 B = 92972 = 154.95 cts/sec

@ ¹³⁷Cs energy of .661 MeV

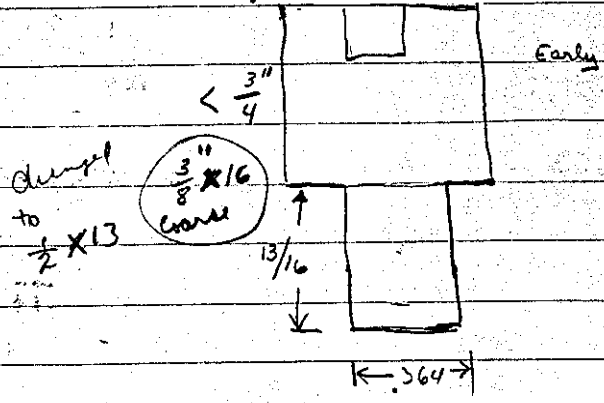
Calc total EFF = 0.0285 } .01525
 Peak/total = 0.535

B = 1.0346 A

A x $\frac{1}{.01525}$ = 9.822 Dis./sec.
 B = 10.161 Dis./sec.

Haynie ²⁵²Cf Pellet .250 od x $9\frac{3}{16}$ high
 Matherie O.D. 0.364 .050 mils bottom
 Shipwreck ²⁵²Cf
 Manthos

Raywood Am Be Source 1" x 1 1/2"
 Am B 5 x 10⁶



Source Distance
 above bottom $\frac{.050}{.94}$
 .144

1365

5 in
 ch

Standard Pile Irradiation by Blosser #1, #2, #3.

#1 1.3546×10^4 Th neut/cm² sec Cd Ratio 18.07 for Cu
 Av Eff = 0.03238 to check calibrations of 3 in scintillator for
 0.005 in thick Cu foils. Position annihilation
 is somewhat a function of foil thickness - preliminary
 measurements ^{indicated} increased counts (by about 10%)
 when 0.010 foil (unirradiated) was placed on top of
 irradiated 0.010 foil ^{which was} at a distance of 2 cm from 3 in.
 Scintillator.

Re TV Blosser Slot #1 Cd Ratio = 18.07

$$\text{Cd Ratio} - 1 = 17.07$$

$$\frac{1}{\text{Cd Ratio} - 1} = .05858 \text{ fast act}$$

$$\text{Fraction Thermal act} = .94142$$

For a $1/v$ absorber, epical activation -

$$\int_{0.4}^{10^6} \phi(E) \Sigma(E) dE = \int \frac{\lambda}{E} \Sigma_0 \left(\frac{E_0}{E}\right)^{1/2} dE$$

$$= \lambda \Sigma_0 E_0^{1/2} \int \frac{dE}{E^{3/2}} = \lambda \Sigma_0 E_0^{1/2} \left[\frac{-2}{E^{1/2}} \right]_{0.4}^{10^6}$$

$$= \lambda \Sigma_0 E_0^{1/2} \left[2 \left(\frac{1}{0.4^{1/2}} - \frac{1}{10^3} \right) \right] \approx .25$$

$$\approx \lambda \Sigma_0 \times 2 \times \left(\frac{0.025}{0.4} \right)^{1/2} = 2 \lambda \Sigma_0 (.0625)^{1/2}$$

$$= 0.5 \lambda \Sigma_0 \quad \text{Thermal act} \rightarrow .886 \Sigma_0$$

#3
Ca

$$\frac{\text{fast act}}{\text{Thermal act}} = \frac{.05858}{.94142} = \frac{0.5 \lambda \Sigma_0}{.886 \Sigma_0}$$

$$\lambda = \frac{.886 \times .0622}{0.5} = 0.110$$

for Sect #1

For water trap (eta), $\lambda = 0.016 - 0.018$ at center
near fuel $\lambda \approx 3\lambda_c \approx 0.05$.

For measurements in copper, if $\lambda \approx 0.05$

$$\frac{\text{fast}}{\text{th}} = \frac{0.5 \times 0.05}{.886} = \frac{.025}{.886} = .0222$$

at distances greater than 7cm (epi spectra)

$$= \frac{.0222}{3} = .0074$$

One may conclude that the correction for epi thermal activation in $1/2$ detectors, in water with fission source neutron spectra, is less than 2%.

(12.87 hr half life $\lambda = 1.456 \times 10^{-5}$)

Aug 14, 10⁰⁰ start irradiation of 2 ea 1" sq x 0.10 Cu foils
2⁴⁵ stop " Pa Be source M-226

Foils separated from source edge by 0.30 in of CH₂

#18 $\rightarrow 0.765 \times 10^{-3}$
#18 $\rightarrow 0.733 \times 10^{-3}$

$$46822 \times 1.496 \times 10^{-5}$$

$$.5 \times 2.54 = 2.0 \text{ cm}$$

See	#18	S.A =	46822 x 1.496 x 10 ⁻⁵	.91001	wait
Count			.78171 x .91001 x .02639	.21829	ERP
charts			.01377	.97341	Count 30
		=	37.76		
		Eff .0969	$\rightarrow 383.5$	.19 BT fast	$\rightarrow 1392.1$
		1.459	264.5	0.4 = 0.2903	$\rightarrow 4.795 \times 10^4$
					1.13 = 5.418×10^9
					2.3×10^9
					$.742 \times 10^2$

.010 WIDE
CUT SPACING

2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

2.5, 3.0, 3.5, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

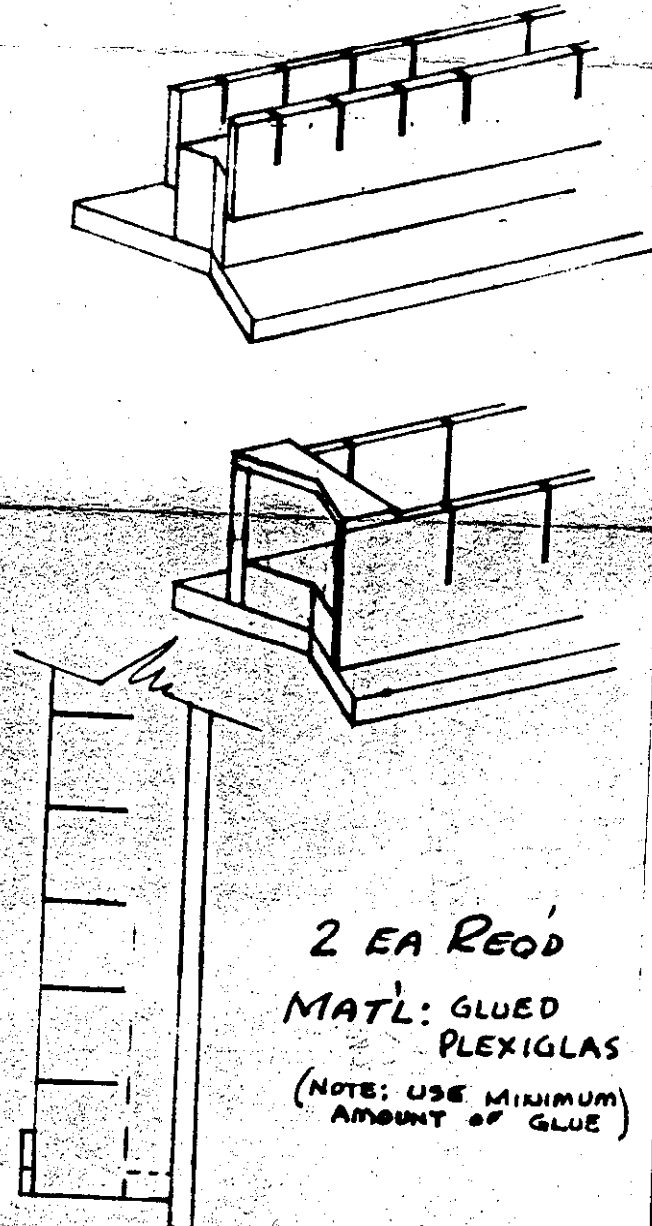
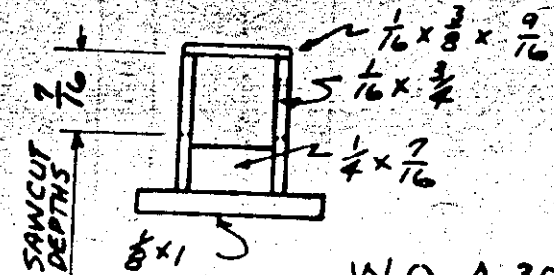
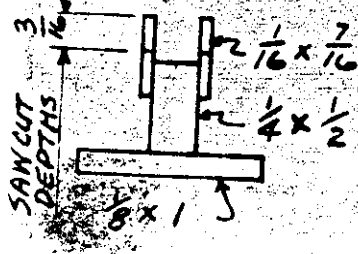
2.0, 2.5, 3.0, 3.5, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

1.50, 1.00, .50

21

2.4 MUST BE STRAIGHT IN ALL PLANES

.010 CUT SPACING
12.0, 14.0, 16.0, 18.0, 20.0



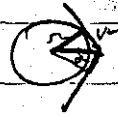
2 EA REOD
MATL: GLED
PLEXIGLAS
(NOTE: USE MINIMUM
AMOUNT OF GLUE)

9213
Co. SOURCE
FOIL HOLDER

TUNNELL 8-9-68

W.O. A-3021Y-A1

Foil holder distances from center of V-notch
with .365 source diam



$$\cos 30^\circ = .866 = \frac{r}{d}$$

$$d = \frac{r}{.866} = \frac{.1825}{.866} = .211$$

$D = 0.75$	$r = .375$	$d = .433$	ind	.217
$D = 1$	$r = .5$	$d = .577$		.289
$D = 1.25$	$r = .625$	$d = .722$		.361
$D = 1.5$	$r = .75$	$d = .866$		.433

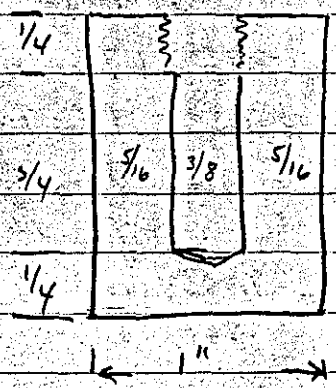
↑

Contact distance from center of V-notch, $\sin 30 = \frac{1}{2}$, r

$$.211 \times .25 = .4625 \times 2.54 = 1.18 \text{ cm } 361$$

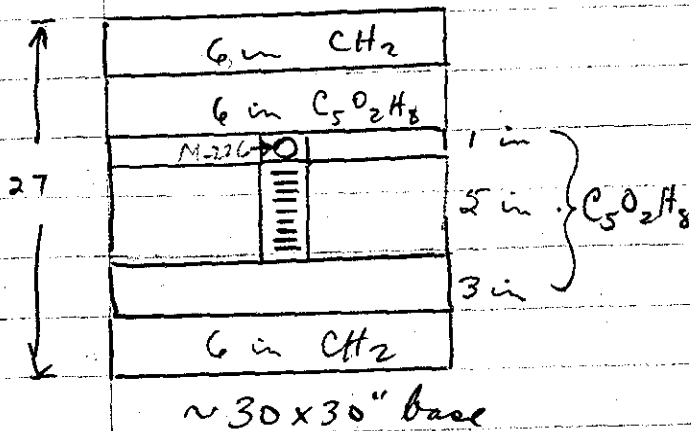
Garrison made Alum shield plug to surround source
1" O.D x 1.25" high

Source handle
2 1/2 ft.
Source set handle
3 1/2 ft.



Stacked Polyethylene + Plexiglass for
 copper foil irradiations, 0.9" dia x 0.005" thick
 .5, 1, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5 inches
 #19, 18, 17, 16, 15, 14, 13, 12, 11.

away from edge of 1x5 Pu Be Source M-226, $7.3 \times 10^6/\text{sec}$
 Start Irradiation at 14:35 P. Aug 16
 Stop at 9:45 A Aug 17
 67hr 10'



M-226 source strength
 is ~~7.93~~ 7.93×10^6 June 15, 61
~~is 8.21 x 10^6~~
 1.035
~~x 1.035~~ $\times 1.035$ ~~is 8.21 x 10^6~~
 $= 8.21 \times 10^6$ n/sec
 (79.88 g of Pu)
 37.13 g of Be

#19 - 31,164 net counts, 441g \pm 70,667

Exp time 67hr 10' $e^{-\lambda t} = .02990$.97010

Delay Time 1hr 15' $e^{-\lambda t} = .93452$

Count time 1hr $e^{-\lambda t} = .94756$.05244

$0.4754 \rightarrow 1.4865$
 $\times 10^6$

$$\phi = \frac{1.4865 \times 10^6}{.5926 \times 10^2} = \frac{2.740 \times 10^4}{8.21 \times 10^6} = 3.34 \times 10^{-3}$$

#17

35,050 Decay Time = 1hr 36' add 91742
 38,205 $\rightarrow 8.036 \times 10^6 \rightarrow 4549 \rightarrow 1.286 \times 10^4$

4.01×10^3

With tap water in 48" od tank
 and Plexiglas foil holder for 0.9 in foil.005
 at 1/2, 1, 1 1/2, 2, 2 1/2, 3, 3 1/2, 4, 5, 6
 I 4, 5, 6, 7, 8, 9, 10, 20, 21, 22.
 away from Pu Be Source M-227
 start irr at 16:50 Aug 16

M-227 → 8.18 ^{apr 12 65}
~~7.75~~ × 10⁶ ~~g~~ ~~15, 1964~~
 ~ 0.5% growth per year (× 1.035)
 8.30
 = ~~8.21~~ × 10⁶ n/sec
 79.65 g of Pu
 36.57 g of Be

eng. 10
 6.1
 growth/yr

1.4265
 × 10⁶
 → 7.01 × 10⁹
 × 10⁴

Savannah River

R.A. Moyers, Experience with Transplutonium
Elements, Health Physics 15, 133-138 (1968)

$$t_{1/2} (\text{Spont Fiss}) = 85.5 \pm 0.5 \text{ yr}$$

$$t_{1/2} (\text{alpha}) = 2.646 \text{ yr}$$

$$\lambda = 3.80$$

$$2.43 \times 10^{12} \text{ n/sec gram } ^{252}\text{Cf}$$

$$544 \mu\text{g} = 1.32 \times 10^9 \text{ } \frac{1}{s} = .7564 \times 10^{-9}$$

$$\lambda(\text{SF}) = 2.568 \times 10^{-10}$$

$$\lambda(\alpha) = 0.8299 \times 10^{-8}$$

$$\lambda(\text{SF}) + \lambda(\alpha) = \frac{.0257}{0.8556 \times 10^{-8}}$$

44
1000

2 m
2.8 A: ~ 31 m

1.5

2.4

8-28-68 Wagner Source Strength
 7.23×10^8 n/sec $\pm 5\%$

$t_{1/2} = 2.646$ yr $\rightarrow \lambda = 0.830 \times 10^{-8}$ sec

If $t = 5$ days $\tau = 5 \times 24 \times 3600 = 4.32 \times 10^5$
 $\lambda \tau = 3.58 \times 10^{-3}$
 $e^{-\lambda \tau} = .99642$

July 10 to Aug 23 = 44 days

If date June 23 - Aug 23 = 60 days

$\tau = 60 \times 3600 \times 24 = 2.16 \times 10^5 \times 2.4 \times 10^1 = 5.184 \times 10^6$

$\lambda = 8.556 \times 10^{-8}$ $\lambda \tau = 0.044$ $e^{-\lambda \tau} = 0.96081$

$\times .9956 = .9566$

$7.76 \times 10^8 \times .9566 = 7.42 \times 10^8$

~~Teflon~~ Teflon Dim. and weights 203

Teflon-U 6 layer U $1\frac{1}{32}$ ($\frac{7}{32} + \frac{1}{4}$ on bottom, $\frac{1}{4}$ on top) 204

Teflon-U 6 layer U @ $\frac{5}{8}$ 207

Teflon-U 6 layer U @ $2\frac{1}{32}$ ($\frac{7}{32} + \frac{1}{4}$ bottom, $\frac{1}{16} + \frac{1}{4}$ top) 211

Plexiglass weights $\frac{1}{2} \times \frac{1}{2} \times 1\frac{1}{2}$ 216-

6 layer @ $\frac{1}{2}$ = 3.00 (42.000 U, 3.70.1 g Plexi) 219

5 layer @ $\frac{1}{2}$ = 2.50 223

8 layers @ $\frac{1}{2}$ = 2.00 227

5 layers @ $\frac{1}{2}$ = 3.125 231

Pol. Refl. 4 layers $2 \frac{1}{4} U - M - T - R$ $2 \frac{1}{4} U = 2.111$ $\Delta k = 14.29$ 179
 31.771 kg U

Pol. Refl. 4 layers $\frac{1}{2} U - \frac{1}{2} L - R$ $\Delta k = -1.94$ 185
 30.66 kg U 3553 g CH₂ (2.483")

CH₂ Refl. 2 layers $2 U - 3 \frac{1}{2} L - 1 \frac{1}{2} R$ $\Delta k = 20.04$ 188
 28.64 kg U 724.6 g CH₂ (2.851")

CH₂ Refl. 6 layers $7 \frac{1}{2} U - 2 \frac{1}{2} L - 2 \frac{1}{2} R$ $\Delta k = -17.84$ 191
 27.703 kg U 671.6 g CH₂ (2.923")

CH₂ Refl. 12 layers $7 \frac{1}{2} U - 1 \frac{1}{2} L - 1 \frac{1}{2} R - 2 \frac{1}{2} S$ \rightarrow Subcrit 193
 29.4 kg U
 +8 pc { 071.6 Subcrit -384
 +14 pc { 104.0 +28.7
 +12 pc { 147.0 0 \rightarrow 2.894"

CH₂ Refl. 6 layers $\frac{1}{4} U - 1 \frac{1}{2} L - \frac{1}{2} R - 1 \frac{1}{2} S$ $\Delta k = 24.14$ 196
 3.415 kg U
 -6 pc 0.015 $\Delta k = -9.14$
 14"

CH₂ Refl. 11 layers $\frac{3}{32} U - 3 \frac{1}{2} L - 3 \frac{1}{2} R$ $\Delta k = -4.74 - 3.64$ 199
 4.203 kg U
 15.712 kg U
 2355.85 g CH₂
 1 ea 0.250 + 2 ea 0.015
 +10 pc (5 layers) 0.015

- (12) U Metal 4 layers $\frac{1}{2}$ [⑩ with 22.4g CH_2] 99
- (13) U Metal 8 layers @ $\frac{1}{4}$ = 2.00 103
(1ea $\frac{1}{4}$ + 2ea $\frac{1}{16}$) CH_2 + extra Fuel
- (14) U Metal 8 layers @ $\frac{1}{4}$ = 2.00 109
1ea $\frac{1}{4}$ + 2ea $\frac{1}{16}$ + 1ea 0.015
- (15) U Metal 8 layers @ $\frac{1}{4}$ = 2.00 115
1ea $\frac{1}{4}$ + 2ea $\frac{1}{16}$ + 2ea 0.015 4 layers
+ 1ea 0.015 2 layers
- (16) U Metal 4 layers @ $\frac{1}{2}$ = 2.00 119
Same Matl as above exc. 8 pc \emptyset .015 X 5 X 10 Removed
- (17) U Metal 6 layers @ $\frac{1}{4}$ = 1.50 125
w. 2ea $\frac{1}{4}$ 3ea $\frac{1}{16}$ in each CH_2 layer
- (18) U Metal 6 layers @ $\frac{1}{4}$ = 1.50 131
→ { 3 layers 2ea $\frac{1}{4}$ + 3ea $\frac{1}{16}$
3 layers 2ea $\frac{1}{4}$ + 3ea $\frac{1}{16}$ + 1ea 0.015
- Plastic weights .015 x 5 x 5 (5.7780g); $\frac{1}{16}$ x 5 x 5 (22.2052) 143
- (19) U Metal 5 x 10 base area (No CH_2) 144
 $\frac{1}{4}$ x 5 x 5 in CH_2 weights, 154
- (20) U-Metal 5 layers @ $\frac{7}{8}$ 155
(21)
- (22) U Metal 5 layers @ $\frac{15}{16}$ 163
- (23) + 0.015
(24) + 0.015
- (25) U Metal 4 layers @ $\frac{9}{8}$ 175
(26) "

	Uranium sizes & nos & weights	2
①	Uranium Metal 10 x 10 base	7
②	U-Metal - (3.25 in nom + 2 ea $\frac{1}{16}$ x 4 CH_2) 4 layers ($\frac{1}{32}$ U-Metal $\frac{1}{8}$ CH_2)	21
③	U-Metal - 3.00 in nom + Var. in nom CH_2 4 layers $\frac{3}{4}$ U-Metal $\frac{5}{16}$ CH_2 + [$\frac{4}{16}$ + 0.030]	31
④	U-Metal 3.125 nom 5 layers @ $\frac{5}{8}$ U-Metal (2 ea $\frac{1}{16}$ + 2 ea .015)	41
⑤	U-Metal 3.00 nom 6 layers $\frac{1}{2}$ U - 3 ea x $\frac{1}{16}$ exc 6 th layer 12 ea .015	51
⑥	U-Metal 3.00 nom 8 layers 2 ea $\frac{1}{16}$ + 1 ea .015 CH_2	61
⑦	U-Metal 3.0625 nom 7 layers @ $\frac{7}{16}$ 2 ea $\frac{1}{16}$ + 1 ea .015 CH_2	71
⑧	U-Metal 3.00 nom 3 layers @ 1 in. 6 ea $\frac{1}{16}$ x 5 x 10 x 2 CH_2	77
⑨	U-Metal 3.1875 nom 3 layers @ $\frac{17}{16}$ CH_2 @ 3 ea $\frac{1}{16}$ + 2 ea .015	85
⑩	U-Metal 2.50 nom. 5 layers @ 0.50 CH_2 @ 1 ea $\frac{1}{4}$ + 2 ea $\frac{1}{16}$ + 3 ea .015	91
⑪	U-Metal 2.00 nom 4 layers @ 0.50 3 ea $\frac{1}{4}$ CH_2	97
	Plastic $\frac{1}{4}$ x 5 x 10 weights	96