BOOK43R

Notes:
"ETΔ" on spine

Blank pages: page opposite page 1, 2, 4, 8, 12, 26, 37, 38, 48, 55, 56, 72, 110, 125, 126, 205, 208, 209, 216, 220, 222, 260, 261, 266, 267, 300, inside opposite page 300

-slip of paper between pages 24/25
-piece of paper between pages 34/35
-page 115 has red marker at top of page
-page 205 has big sheet taped to it
-page 209 has 2 sheets taped to it
-page 230 has sheet taped to it
-piece of paper between pages 260/261 (very light print)
-3 extra large sheets taped to inside back cover sheets

Scanned by:
Sheila Finch
RSICC /Oak Ridge National Lab.
August 11, 1999

DW Magnuson

1-58 to 2-59

Log book given to R.G.Wick

by S.T. Thomas

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Notebook Summary

Page	Topic
3	D_2O Analysis
127	27" sphere

1-30-58

25 gallons of D_2O shipped by C. Pigott (1-29-58)

Analyses by W. F. Cameron

Atom % D	99.79
Atom % H	0.21
grams D/gram soln	0.20079

PuBe Sources ordered for South wing

① 1×10^7 ~ 1" x 5" with $\frac{1}{4}$ x 20 machine thread

② 1×10^6 ~ $\frac{3}{4}$" x 2" with 10-32 machine thread

Tad Adder Calibrations

2" OD S.S. Tubing 72.0" long

ID. OD 1/2" Tubing 6.0" long } .065 wall
ID. OD 1/2" Tubing 6.0" long }

Volume 2740 cc @ 25° H_2O − 20cc volume of leads

Weight 6.05
Tare 3.29
Tare (Tubing) .03
2.72 kg H_2O @ 25°

$\frac{2720 cc}{72} = 37.78$ cc/in

Remeasured Volume (with wet walls) = 2735 less 20 cc volume of 1/2" tubing leads
= 2715

1" OD S.S Tubing 72.0" long
1/2 OD 6.0" } .065 wall
1/2 OD 6.0" }

Volume 613 cc − 21 = 592 cc
weight 2.32
1.69
.630
Tubing Tare .30
.600 kg H_2O

$\frac{592}{72} = 8.22$ cc/in

Calculated volumes of 2" Tad Adder

Tad Adder Tare wt 3.29 kg $= \frac{\pi}{4}(D_1^2 - D_2^2)\rho L$

$3.29 = .7854 \times 16.39 \times 7.55 \times 72 \,(D_1^2 - D_2^2)$

$(D_1^2 - D_2^2) = \frac{3,290}{.7854 \times 16.39 \times 7.55 \times 72} = 0.459$

$D_2^2 = 4 - 0.459 = 3.541$

$D_2 = 1.882$

Wall thickness $= \frac{.118}{2} = 0.059$

N.B. The tare weight is uncorrected for weldments ~~caps~~ and tube on ends.

Assume 2" OD Tubing 065 wall $\therefore$ ID = 1.870

Volume $= \frac{\pi}{4} L D^2 \times 16.39 = .7854 \times 72 \times 1.87^2 \times 16.39 = 3243$

Assume Meas volume of 2720, calculate D_{eff}

$D_{eff}^2 = \frac{3270}{16.39 \times .7854 \times 72} = 2.92$

$D_{eff}^2 = 1.71$

$\therefore$ Outer wall O.D. = 1.84 if wall is 065

But Measured with Calipers ~ 2.00 inches.

Micrometer measurements averaged 2.008
Rotate 90° to above averaged 2.012 } 2.010"

$\therefore$ Measured Outside diameter = 2.010"

From meas OD = 2.01 and wt

Calculated $D_2^2 = 4.040 - .459 = 3.581$

$D_2 = 1.892$"

Vol $= \frac{\pi D^2}{4} L \times 16.39 = .7854 \times 1.892^2 \times 72 \times 16.39$

$= 926.88 \text{ cc/in}^2 \times 3.580 = 3318$

Measured O.D = 2.01 $D_1^2 = 4.040$

Vol Calc I.D 1.71 $D_2^2 = 3.541$

.499

$.7854 \times 16.39 \times 72 \; \rho (D_1^2 - D_2^2) = 3290$ g

$\rho = \frac{3290}{926.8 \times .499 \times .4625} = 7.114$

However no steels in Rubber Handbook have densities that low!

Conclusion:

One must set up and calibrate accurately with small increments, and this will be easiest with the automatic manometer reader on order from Fargo Larson.

ERROR IN LENGTH MEASUREMENT

L = 60.0 inches

$(OD)_{ave} = 2.010$ $\rho(316) = 0.289$ lbs/in³

If wall = 065 ID = 1.88 $D^2 = 3.5344$ $= 27.68 \times 0.289$

$\frac{\pi}{4} D^2 L \times 16.39 = .7854 \times 60 \times 16.39 \, D^2 = 772.37$ $= 8.000$ g/cc

Vol (calc) = 2730 cc

System Volume Calibration and Leak Check

Sight glass Reading	Auto. Liquid Level Manometer	Volume added	Total Volume
~~3/8~~			
3/8"	00.000	1.0 ℓ	1.0 ℓ
1 1/4"	00.564	2.0 ℓ	3.0 ℓ
1 31/32"	01.469	2.0 ℓ	5.0 ℓ
2 11/16"	1.985	2.0 ℓ	7.0 ℓ
3 7/16"	2.519	2.0 ℓ	9.0 ℓ
11 1/16"	10.077	21.0 ℓ	30.0 ℓ
18 3/4"	17.717	21.0 ℓ	51.0 ℓ
26 1/4"	25.950	21.0 ℓ	72.0 ℓ

Noticed that plastic tube is not straight enough
Balance point is dependent on horizontal position.
Also the float acts as a piston -- it does not move freely enough in the tube.

33 7/8"	33.350	21.0 ℓ	93.0 ℓ
41 1/2"	40.882	21.0 ℓ	114.0 ℓ
49 3/16	48.569	21.0 ℓ	135.0 ℓ
49 7/8	49.333	2.0 ℓ	137.0 ℓ
50 1/2	50.005	2.0 ℓ	139.0 ℓ
51 1/32		2.0 ℓ	141.0 ℓ
51 11/16		2.0 ℓ	143.0 ℓ
52 5/16		2.0 ℓ	145.0 ℓ
53 [illegible]0		2.0 ℓ	147 ℓ
53 11/16		2.0 ℓ	149 ℓ
~~55.0~~		4.0 ℓ	153 ℓ
56 7/16		4.0 ℓ	157 ℓ

3-14-58

Central cylinder filled with Deionized H_2O

Water height = 72 - 28 = 44" H_2O

3-18-58

Source PN 914 installed in reactor source thimble so that limit switch stops source ~14" reactor solution height

3-18-58 Measurement of lead resistance in thermocouple by shorting thermocouple with clip lead. #3

100 Ω std thm read 1.0733 X .1 volts drop

#3 thermocouple read .0029 X .1

$100 \times \frac{.0029}{1.0733} = .27_0$ Ω resistance of lead to thermocouple #3 (wire X-31)

The length of cable wire X-31 is then

$\frac{.27}{.002525} = 107$ feet

Therefore Standard should be balanced at 0.9973

~~1.0027~~

3-18-58 zeroed the liquid level device with solution in reactor, tape on liq. level reads 98.805"

3-19-58

Transferred solution of $\frac{\#}{x}$ x 290 to system

Bottle	102	17.345		
		2.369 tare		
		14.976 kg soln		
	103	17.425		
		2.372		
		15.053 kg Soln		
3-20-58	103	17.375		
		2.372		
		15.002 kg soln	45.031	
	102	17.850		
		2.369		
		14.981	59.811 kg soln. system	
	103	7.590		
		2.372		
		5.22	65.03 kg soln	

3-20-58 Experiment #1 ERR. Dwm. CC.

with approx. 41 l of solution in tank

to check system (46 l required from prev. meas.)

Instruments checked by V. H, ERR.

	Background	C_1	C_2	C_3	K
	" 98.806	2 x16 +13	9 x16 +1	243 x16 +2	2.5×10^{-13}
	Liq Level ~~6.094~~	Feed rate ~ 1"/30 sec or 2"/Min.			
	6.094	3 +6	8 +11	260 +0	
Sol.	9.053	2 +0	8 +5	278 +4	
25.62°	12.079	4 +0	11 +4	355 +15	4.3×10^{-13}
	13.014	7 +8	16 +12	519 +11	5.5×10^{-13}
	13.999	14 +5	25 +15	206 x64 +15	7.2×10^{-13}

Out of comp.

Inserted safety blade fully 5.6×10^{-13}

Drain comp.

Exp #2 Reading on sight gauge ~ 20 3/8 → 56 liters → 57.8 kg

		C-1	C-2 x16	C-3 x64	Kr:Hc	B·V·L
	Bkgrd	1 +1	8 +9	246 +1	2.6×10^{-13}	7×10^{-13}
Sol. T ~~26.64~~ 26.72	14.113	3 +11	30 +5	.269 229 +47	7.6×10^{-13}	1.4×10^{-12}
	jogged source out and back in					
	15.099	4 +6	48 +13	.155 398 +22	1.6×10^{-12}	2.2×10^{-12}
~~25.64~~	15.972	4 +6	77 +7	.094 164 x256	2.1×10^{-12} ~~3.7×10^{-12}~~	3.8×10^{-12}
26.64	17.063	6 +3	138 +11	.0514 298 157	3.6×10^{-11}	6.5×10^{-12}
	18.09	7 +14	268 +10	.0269 571 256 +225	7.2×10^{-11}	1.3×10^{-11}
	18.96	317	146 x64	0174 Reg Jam.	1.59×10^{-10}	2.8×10^{-11}
	19.50 out of comp.					

EXP #3

Added scrap. Total 65 kg soln by cart transferred

Critical @ 4:05

Liq Level		T.A.
19.888	slipper slightly	
19.886	and critical	
19.887	level	12.45
19.885+	neg period on Keithley, Back, (Beech log)	11.86 T.A.
	Not reproducible T.A to 17.17	
19.922	Pos period.	17.17
19.918	level	12.13
19.924	Pos. Period	17.17

to let Keithley Meter trip scram. @ 4:25

Shut down system. By closing valve to tank.

3-21-58 EXP #4 (15" Annulus)

Purpose: check critical lvl, rod adder, pos and neg periods dump valve and reactor stability

Critical cond.	Liq. Level	Rod Adder	Safety
No Soln	98.800	17.15	21.00
~Finish rinse or dist.	11.00		
$I_{C-3} = 1.6 \times 10^{-12}$	14.00		
$I_{C-1} = 8.4 \times 10^{-13}$			
	18.196	17.15	
	18.212	16.00	
	18.212	15.00	
	18.212	14.00	
	18.210	13.00	
	18.207	12.00	
	18.200	11.00	
	18.193	10.00	
	18.189	9.00	
	18.184	8.00	
	18.180	7.00	
	18.161	6.00	
	18.142	4.00	
	18.132	2.00	
	18.126	.05	
Liq level not reproducible ←	18.589	17.17	
	18.556	.05	
	18.646	17.17	
	18.609	.05	

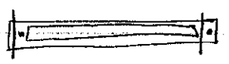
Annular cylinder volume $= \frac{\pi}{4}(D_1^2 - D_2^2)L$

Vol/in $= \frac{\pi}{4}\left(15^2 - \frac{6^2}{199}\right) \times 16.39 = 2435$ cc/in

$\frac{37.78}{2435 \text{ cc/in}} = .0155$ in/in or 15 mils/inch rod adder

~~With rod~~ By going out in reactor room to observe float in liq. level one could see that the surface tension was causing it to ~~stick~~ stand.

A new float was made from hollow polyethylene with OD=.250 ID=.190 and 5 5 fingers to act as guides. OD .350



The inst was rezeroed. The black tape now reads 99.146 (no solution in system)

Exp #5 ERR DW Sh C.E V.H.

Purpose to check reproducibility critical ht, tad adder, etc.

Conditions	Liq. Level	Tad Adder	Safety	
Sub.Crit.	18.857	17.19	21.01	.32 $\times 3\times10^{-10}$
"	18.553	.05		.30 $\sim 3\times10^{-11}$
"	18.860	17.14		.39
"	18.554	.05		

the reproducibility of level is very good

"	18.691	8.06		
Critical	20.040	8.06		.80 $\times 3\times10^{-11}$

N.B. Change over from Beckman VL to ORNL log N scrammed system on period scram.

Slightly Super	Critical 27.34°C	20.004	8.06	22.01	
"	"	20.001	7.97		
	Sub Crit.	19.988	7.40		
	Super	19.998	7.66		
	Super	19.993	7.51		System reactivity apparently changing, temp is changing too.
	Super 27.14	19.989	7.40		
	Super	19.985	7.20		
	Super	19.978	6.80		
#1	Subcrit 27.16	19.969	6.00		
#2	Pos Per. 27.10	20.077	12.02		
#3	Level 27.08	19.964	6.08		

		Liq level		
#4	Neg Period 27.02	19.862	.05	
#5	Level	19.965	5.45	

Lowered magnet current to ~8 MA to drop Safety Blade. Zero on Liq Level 99.146

3-24-58

The system seems to take an excessive time to stabilize at critical ~35 minutes. Using the period — Δh calibration the critical height change from 20.004 to 19.967 (0.037") corresponds to a reactivity change of 1.94 ¢. It is possible that the solution is in motion and the long time represents the decay of the currents and eddies in the solution

#2 pos period 6.8 div → +148 sec → 7.2 ¢

Δh = 0.110 or 0.113 } 0.111 5"

$\frac{\Delta\rho}{\Delta h} = \frac{7.2}{0.1115} = 64.6$ ¢/inch

#4 neg period 9.3 div → −202 sec → −8.0 ¢

$\frac{\Delta\rho}{\Delta h} = \frac{8.0}{.1015} = 78.8$ ¢/inch Δh = .102 / .103

Average solution worth = 71.7 ¢/inch

3-24-57

Exp #6 Purpose to check circulation thrum of solution by feeding prickly and watching drift.

		Liq Level	Safety
9 26	Start pump and feeding — air in pump Source is in	99.144	22.00
9 27½	Start pump and feeding lost float drain back		
9 30	Start feeding —		
9 31		2.30	
32		4.17	
33		6.00 ~~4.17~~	
34		7.72	
35		9.44	
36		11.12	
39		15.87.	
43		18.802	T. A
45½		19.625	
	lower tad	7.57.	
48		19.69	
49	Source out	19.892	slightly super
	Low Tad 9.	19.870	6.39 " Sub
55		19.868	6.39 Critical
1 00	T = 23.05	19.867	6.39 actually sub slightly

Since solution did not warm up excessively it seems that the previous drifts can be explained by temp changes System now seems stable

05		19.877 ↓	6.85 ↓ Super
		19.868	6.60
10 10	23.05°C	867	6.60
21	23.08°C	865	6.60
30		.864	6.60

		Liq level	Tad	
31		19.866+	6.66	Slightly sub.
35		19.865	6.66	Still sub
10 37		19.872	6.70	
43	23.11°C	19.870	6.70	Level
	To go on +15 sec period			
45		19.980	12.70	
	+ Period			
59		19.868	6.88 ↓	sub
1101		19.872	6.97 ↓	Super Back on N ~1.35
		19.871	6.93	
06		19.870	6.93	~~Level~~ on N ~1.35
09		19.870+	6.93 ↓	super
11: 11	23.18	19,869	6.87	level
	Neg Period			
11 12		19.747	.05	
16		19.746	0.05	
19		Start to level		
24		19.869	6.83 ↓	sub
26		19.870	6.91	
29		11	11	level o ram rod button

3-24-58

Pos Period 5.8 div → 126 sec → +8.1 ¢

$\Delta h = 0.110$

$\frac{\delta g}{\delta h} = \frac{8.1}{.11} = 73.6$ ¢/inch

Neg Period -7.8 div → -169.4 sec → -10.1 ¢/sec

$\Delta h = 0.124$

$\frac{\delta g}{\delta h} = \frac{-10.1}{-.124} = 81.5$ ¢/inch

average $\frac{\delta g}{\delta h} = 77.05$ ¢/in

Crit ht = 19,870

Temp = 23.11 °C

from p 17 Crit ht = 19.964

Temp = 27.08

$\frac{\Delta h}{\Delta t} = \frac{.094}{3.97} = .0237$ in/°C

$\frac{\delta g}{\delta t} = -.0237 \times \frac{77.05}{-1.83} = +.774$ ¢/°C

however Calibration of Beckman Log N was ∴

10^{-11} read .95 $\times 10^{-11}$ on recorder

10^{-8} read 1.13 $\times 10^{-11}$ on recorder

∴ No of div per decade is too small

and data must be multiplied by 1.06.

+ period 5.8 × 1.06 = 6.15 div → 134 sec → +7.7 ¢ 70.0 ¢/in

− neg 7.8 × 1.06 = 8.27 div → 180 sec → −9.4 ¢ 75.8 ¢/in

Aver 72.9 ¢/in

$\frac{\Delta h}{\Delta t} = 0.0237$ in/°C

$\frac{\Delta g}{\Delta t} = 0.0237 \times 72.9 = -1.73$ ¢/°C

3-26-58 Experiment #7 RWM,

Mercury thermometer taped on thermistor 24.6 °C

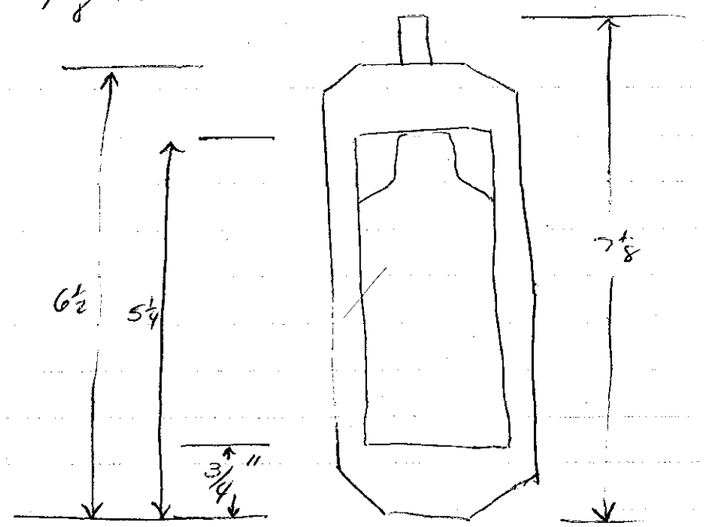
Resistance thermometer thermistor #4 24.86 °C

Bottle #24 filled with Demin H_2O Gross Wt 155.880 g

tare 20.322

H_2O 135.558

Zero positioning of bottle



Top of plug set so that 74.00 on selsyn reads on indicates that the top of the bottle holder is at 74"

Middle of bottle is 3⅛" lower

Bottle completely submerged 42.75"

Bottle bottom is very close to bottom @ 7.20"

(From top setting bottom of bottle should be at 7.125" plus thickness of inner cyl bottom + spacing

3-27-58

Exp #7 Aw/m C.C R.g.

Liq Level zero 99.150 Back Log N { $10^{-8} = 10^{-8}$ / $10^{-11} = 10^{-11}$ } Recorder

N 9[50] AM	Start Soln Liq Level	T.A.	Safety	Bottle #24	
951	4.15	17.14	22.04	42.59	
52	6.08				
10[00]	17.38	8.02	"	"	
10[11]	Source out				
12	19.950	8.43			
13	19.947	8.43	Super		
16	19.927	8.22	Super		
21	19.923	8.01	Super		T = 24.84°C
25	19.922	7.91	"		
28	19.920	7.82	"		
37	19.916	7.61	Level		T = 24.84
37¼	Start moving bottle into reactor				
43	.915	+ period	14.70 ~~14.67~~		
48	.914	7.61 + period	14.70		
53	19.852	4.09	14.70		Nearly level
55	.851	4.03	14.70		" "
59	.850	4.03	14.70		

Bottle started out.

Changed range on Keithley holding meter bypass but the fast scram ckt scrammed system on the transient

$10^{-11} = .98 \times 10^{-11}$ } on recorder

$10^{-8} = .96 \times 10^{-8}$ }

Log N Beck $10^{-8} = 10^{-8}$ / $10^{-11} = 10^{-11}$ } recorder

Zero on liq level 99.151

Experiment #8 Aw/m C C Rg

	Liq Level	T.A.	Safety	Bottle	Bottle #24	
12 23	3.982	17.17	22.01	42.88		
24	4.75					
25	6.75					
12 49 PM	19.965	10.00	22.01	42.80		Near Crit. super
58	61	9.82				
58		9.65				
1 00 PM	19.957	9.50				
03	"	9.50				New Critical
05½	956	9.37				
07	954	9.21				
13	.954	9.21	→ 22.01	42.80		Critical T = 25.20
	Bottle #24 going in.					
17½	Bottle #24 @	→ 14.70				
~25	Level with Tad adder					
30	.874	5.46	22.01	14.70		
32	.874	5.46	22.01	14.70		
	Start Bottle #24 out.					
	Neg Period.			42.44 ~~42.40~~		
1 51	19.956	9.03		42.44		slightly positive per.
55	19.955	8.94		"		
56	Start bottle in neg. period.					

trip during reset of Beckman. Suspect bad trip on Keithley.

EXP #9 Dwm cc RG

Repeat of #7 and #8 for average

	Liquid Level	T.A.	Bottle	Log N	
	19.972	9.25⁻	42.80	0.1	super
3⁰⁶	19.957	7.74	42.80	0.115	25.56°C
3¹⁰	"	"	"	"	Critical
3¹³	Bottle to 14.70				
3¹⁹	19.957	7.74	14.70	~1.0	t per
3²³	Bottle to		42.80		
3²⁶	19.957	7.74	42.80	1.35	slightly super
	Slightly super see linear charts for react #1				
3³⁵	19.950	7.29	42.80	1.6	25.52°C
3³⁹	start bottle in again				
3⁴⁴½	+ period		14.71		
3⁴⁷	19.950	7.29	14.71		
4⁰⁹	start bottle out			~13	
	19.950	7.29	42.79		
3⁵⁸	Slightly super critical see linear #2 charts				
4⁰⁰	19.946	7.14	42.79	~~15.5~~ 15.0	level
01	19.811	.05	neg period		
05	19.812	.05	42.79	neg period	

On negative period, changing ranges on Keithley Reset button doesn't keep Fast scram from dropping safety.

Calibration check of Beckley V showed no drift

Summary of #7 #8 & #9

Bottle centered, Bottle #24 with H_2O

3-27-58	EXP.	Fuel level	T.A.	Bottle	Period	Sd
9.37	7	19.915	7.61	out	∞	0
	"	"	"	in	230.3	4.915
9.59	"	19.850	4.03	in	∞	0
1:13	8	19.954	9.21	out	∞	0
	"	"	"	in	220.5	5.115⁻
1:32	"	19.874	5.46	in	∞	0
	"	"	"	out	-306	-4.85⁻
1.55	"	19.955⁻	8.94	out	∞	0
3:10	9	19.957	7.74	out	∞	0
	"	"	"	in	210	5.33
3.26	"	"	"	out	+2400	0.5-3
	"	19.950	7.29	out	∞	0
3³⁹	"	"	"	in	227.4	4.97
	"	"	"	out	+4500	0.28
4⁰⁰	"	19.946	7.14	out	∞	0
	"	19.812	0.05	out	-177.1	

3PN-95

NUMBER OF POINTS 111

ESTIMATE 3

	PARAMETERS	VARIANCES
B 1	2 40855889	1 58583764
B 2	5 42156986	7 11991074
B 3	4-44372960	4 19757528

CE Y

Exp #10 3-28-58

Source In, Cock safety Blade 12.01, Inst check Reddi on.

	Liq. Level	T_{AD} Added	Bottle	Crit Cond.	Power
9 50 AM	(0) 99.150	17.14	42.79		
52	4.8	"	"	Sub	.0009
53	4.25	"	"	Sub	.0009
54	10.45	"	"		
55	13.543	"	"		.00105
56	14.712				.0015
					.00122
10 00	17.567	"	"		.01
02	17.260	.05			

$\therefore \frac{\Delta ll}{\Delta TA} = \frac{.300}{17.09} = .01762$ $\quad \frac{\Delta TA}{\Delta ll} = 56.8$

06	18.387	.05	42.79			
11	19.725	.05	42.79	Near Crit		.1
	Start Source out					
16	19.956	12.34	42.79	super Source out		.1
18	19.941	11.52	42.79			
20	.941	.52	42.79	super		
23	.931	11.20	42.79	Temp		
				100.04 = 25.10		
25	19.926	10.97				
28	19.926	10.97	42.79	100.038	Critical	.12
34	19.927	10.97	42.79	100.038	Critical	.12
40	19.927	10.97	42.79		Seems to be	
44		→ 10.86			Slightly Super	
46	19.925	→ 10.75				
50	19.925	10.75			Def. Sub. crit.	
58	.931	10.88	— —		Super	
	.	10.78				
11 02	.931	10.78				
	.	10.72				
11 06	.928	10.65				
11 10	.922	10.59			Sub crit.	
		10.62				
11 20	19.930	10.62			Crit.	
	Start bottle in					
11 24	19.931	10.62	14.70		+ Period	
11 30	19.930	10.62	14.70		+ period	
	Start bottle out					

	Liq. Level	Tad Adder	Bottle	Temp	
11 33	19.930	10.62	42.76	100.03$_0$	} level. (very slightly positive
11 40	19.930$_5$	10.62	42.76		

Bottle in and liquid level change to maintain constant Power

11 50	19.857 ↓	6.91 ↓	14.70	
55	19.858	6.96	14.70	100.02$_5$ (Level for 5')
	Start Bottle out			
12 07	.858$_5$	6.96	42.66	Neg. Period Bottle #24
	Start Bottle In			
11	.858$_5$	6.96	14.70	Slightly pos period
12 20 pm	.858$_5$	6.96	14.70	See linear charts.

Start Bottle out add solution level for ~ 3 minutes

12 30	19.922	10.48	42.70	
12 37				Level start bottle in.
12 40	19.923	10.48	14.70	+ Period Bottle #24
12 45	Start Bottle out			
~12 50	Bottle out			100.25
1 00	19.23	10.48	42.84	Slightly out crit — see

Scrammed (red button) linear charts.

99.150

EXP #11 3-28-58

Bottle #24 with 10 ml H_2O removed (N.B Rinsed Pipette twice) and " 10 ml UO_2F_2 soln (19.5 g/l) added

Gross wt 156.063 gm.

	Liq Lev	Tad Adder	Bottle	Temp	
2 05 PM	99.150	17.15	42.73		Safety at 22.01 Source in.
2 06	2.25				
2.09	10.05				
2.13 Pm	17.738	17.15			
	.43 7/8	0.05			
	.301	17.10			
2 30	Source out,				
	19.952	11.51	42.73		Nearly Critical
2 33	Sudden change to + period				
35	19.949	11.32			
36	19.946	11.12 ↓			
40	19.944	11.01 ↓			
		10.87 ↓			
43	19.941	10.73			} level for six min a)
49	19.941	10.73	42.73		
53	Bottle in Pos Period ~ 100 sec				+ Per b)
306	Bottle out				
	19.941	10.73	42.77		non crit c)
3 10	19.736	0.05	42.77	100.11$_5$	neg per. d)
3 22	.926	9.68 ↓	42.77		
23	19.927	9.80 ↓			
		9.88 ↓			
		9.98 ↓			
28	19.934	10.29			8' Level e)
33	19.934	10.29	42.77		start bottle in
37			14.70		
40	19.934	10.29	14.70	100.10$_2$	+ Per. f)
43 1/2	"	"	"	Start bottle out	

	Liq Level	Tad Ladder	Bottle	Temp.	
45			25 +		
48	19.934	10.29	42.75		} very slight + per g)
56	19.~~938~~ 738	.05	42.75		Neg period h)
06	Start ↑ level with T.A				
15	19.938	10.30	42.75		
18	19.938	10.3	42.75	slightly pos.	i)
21	19.936	10.19 ↓ 10.08		100.09₂	
24	19.932	9.95			
30	19.932	9.95	42.75		level or slightly neg. j)
31	Start Bottle down				
35			14.70		
40	19.932	9.95	14.70		pos. Per. k)

Keithley fast scram tripped on scale change.

R.H.
C.O.
D.C.

Exp. # 12 3-31-58

Bottle # 24 with 5 ml of sample soln. ~ 19.6 grams / liter in bottle.

Wt. of bottle filled with H_2O 155.83 grams. 5 ml H_2O removed and 5 ml soln. added

gross weight =

source in, blade cocked

	liquid level	T.A.	Bottle	Temp	
	99.149	17.14	42.77	No solution.	
10[15]		0.2			
17		6.5			
19½		12.5			
25		Rmvd TA x .05			
35		Source out.			
1041	19.881	8.93 ↓ 9.02	42.77	.9983 × 24.6	slightly subcrit.
45					
53	19.896	9.~~11~~ 10			} Level q)
1102	19.896	9.11	42.77 ↓ 14.70		
1106½	19.896	9.11	14.70		} + period b)
12			14.70		
13	Start Bottle out				
17			42.69		} level c (subcrit)
24	19.897	9.11 ↓ .05	42.69		
30	19.722				
42	19.902	9.22	42.69	.99843 → 24.6 °C	
11:51	19.902	9.22	14.70	level start bottle in d	
12.02		bottle started out		period e	
12.06	19.903	9.22	42.72	bottle out + sub f	
12.20	19.719	0.06	42.72	G	
12.30	19.896	9.21	42.72	H	

	Liquid level	T.A.	Bottle	Temp	Comment	
12.43	19.898	9.25	42.72	0.99852 ~ 24.6°		
12.57	19.905 (.903)	9.24	42.72			
1.03	19.904	9.31	42.72			i
1:23	19.905	9.36	14.7			j
1:38	19.905	9.36	42.75	} slightly neg.		k
145	19.905	9.36	42.75		.99853	
	Start Bottle in and level with T.A.					
150	19.793	4.19	14.70	super		
52½	19.790	4.11				
		4.19				
205 PM	19.804	4.14				
	802	4.09				
214 PM	19.800	4.04				
220 PM	19.801	4.04	14.70	Level		l
	Remove bottle for Neg Period					
	19.801 Level with soln	4.04	42.70	}		m
233	19.911	9.32	42.70			
235	19.910 5	9.37		.99853		
240	"	9.42				
245½	19.911	9.50		} 42.70 Level for over 5' minute		
253	"	"				n
	Move bottle in.			.99857		
257	19.911	9.50	14.70	+ period		o
303	"	"	"			
	Move bottle out					
318	Level for the past 7 - 9 minutes					p
	Bottle #24 wt with 5 ml UO_2F_2 Soln and H_2O					
	Gross 155.877 g.					

Exp #13 April 1, 1958 C.C. Dunn RG.

U-233 Sample information

#24 155.890 g Filled with H_2O

Removed 5 ml H_2O

Added 5 ml $UO_2(NO_3)_2$ solution 156.024 g

U^{233} conc approx 18 - 20 g per liter

(Orig sample 9 ml diluted with 75 ml H_2O)

	Lig Level	Tadadder	Bottle	Temp	Safety @ 22.00	
	99.150	17.14	42.71			
10 30 AM	1.0	17.14	42.70			
39	17.680 changing	.05	42.70			
42	17.675	.05	14.70	Check Bottle worth ~½ g Total T. A.		
			42.68			
10 50	19.916	8.45	42.68	Source Out		
		7.98			.99854	
53	19.878	7.82				
	Dumped some solution. Added some from T. A.					
11 00	19.883	8.04				
05		7.91				
08	19.875	7.98			99864	Sub Crit.
18	19.876	8.04				
82	19.875½	8.04	42.68			Crit for 7' a)
	"	"	14.70			pos per. b)
52	19.875	8.04	42.72			Slightly sub c)
56	19.743	0.05	42.72		99880	Neg. to reduce Power d)
12 20	19.888	7.99	42.72			Level for past 5' e)
12 30	19.884	7.99	14.70			pos. period f)
			42.71			

	Liq level	Tad Adder	Bottle	Temp	
12 40	19.884	7.99	42.71	.99890	g)
47	19.884	7.94	42.71		
	Lower Liq level to decrease power			(soln)	
49	19.743	.05		neg per	h)
57	19.879	7.58 ↓ 7.81			
1 00 PM	19.891	7.90			
1 23	19.885	7.98 8.03	42.71	Level	i)
			↓ 14.70	Poo Period	j)
1 37	19.885	8.03	42.71	Slightly	k)
1 50	19.887	8.03	42.71	Sub Crit	
		↓ .05		neg. Period to reduce Power	
2 02	19.890	7.91	42.71	slightly sub .99893	
2 36	19.890	8.13	42.71	≅ level	
2 43	19.890	8.13	14.70	~~Slightly Sub.~~	l)
2 55	19.891	8.13	42.72		m
3 08	99150	Shut down			

Summary Exp 10, 11, 12, and 13

	Exp	Fuel level	T.A.	Bottle	Period	ρ¢	
3-28-58							
11:20	10	19.930	10.62	out	∞	0	Bottle #24 H_2O
	"	19.931	"	in	218.4		
	"	19.930	10.62	out	+		
11:55	"	19.858	6.96	in	∞	0	
	"	"	"	out	-292.3	-5.13	
	~~"~~	~~19.922~~	~~10.48~~	~~out~~	~~∞~~	~~0~~	
12:20	"	19.858	6.96	in			
12:30	"	19.922	10.48	out	∞	0	
	"	"	"	in	233	4.86	
	"	19.923	"	out	-7060	-0.18	

	10 ml	UO_2F_2	Soln	~ 19.5 g/l	in Bottle	#24	
3-28-58							
2:49	19.941	10.73	out	∞	0		
"	"	"	in	98.9	9.94		
"	"	"	out	5773.	0.23		
3:28	" 19.934	10.29	out	∞	0		
"	"	"	in	103.4	9.60		
3.48	"	"	out	+			
"	19.738	0.05	out				
4:30	" 19.932	9.95	out	∞	0		
"	"	"	in	103.6	9.59		

4.764

4.9758 7.4637

2.4579
1.2744
3.7319

VARIAN

I 65D91955

34.7478

3-31-58 Exp # 12 / Bottle # 24 with 5 ml of scintasol

	liquid level	T.A	Bottle	Tare	δt
11:02	19.896	9.11	out	∞	0
	"	"	in	148.6	7.16
11:17	"	"	out	-7700	-0.17
11.51	19.902	9.22	out	∞	0
	"	"	in	145.6	7.28
	"	"	out	-9400	-0.15
	19.905	9.36	out	∞	
	"	"	in	145.6	7.28
	19.904	"	out	-11710	-0.11
2.20	19.901	4.04	in	∞	0
	"	"	out	~~-7.12~~ -2222	-7.12
	19.111	9.50	out	∞	0
	"	"	in	144.7	7.32
	"	"	out	∞	0
					7.32

Exp # 13

4-1-58 (11:32)	19.785	8.04	out	∞	0
	"	"	in	116.8	8.72
	"	"	out	-9920	-0.13
12:20	19.888	7.99	out	∞	0
	19.884	"	in	116.3	8.74
	"	"	out	-21,000	-0.06
	19.885	8.03	out	∞	0
1:23	"	"	in	116	8.76
	"	"	out	-9140	-0.14
	19.890	8.13	out	∞	0
	"	"	in	115.6	8.78
	"	"	out	-18,640	-0.06

4-2-58

Moved Beckman I Ion chamber up on platform within 4' of reactor. this will increase its sensitivity so that the noise will be greatly reduced on the scale used for leveling at the lower power. Keithley recorder was sluggish and bad tubes were found in the two amplifiers

Experiment #14 R G Dwon C.C-

Bottle #24 filled with H_2O 155.855 g Gross

Removed 2 ML H_2O Add 2ml U^{277} soln

The bottle (#24) was found to leak slightly at the cap under Pressure (taking the cap off and squeezing bottle) No leak observed upon inversion without pressure.

	Liq level	Ia à Addn	Bottle	Temp		
	99.150	17.14	42.68			
10 05	Start					
14	17.880	17.14				
16	17.580	↓ .05₅				
30						
31	19.864	9.34				
38	19.864	9.34	42.68	.99696 approx level for 8'		a)
50	Level Inst Bottle					
55	19.864	9.34	14.70		+ Period	b)
11 00	Remove Bottle					
04	19.864	9.34	42.71	} .99698	} level	c)
11 11	19.864	9.311	42.71			
		↓ .055				
16	19.706				Neg Period	d
		↓				
25	19.874	9.38				
		↓				
28		9.32				
		9.26				

	Liq. Level	Tad Addev	Bottle	Temp
11:30	19.871	9.26	42.71	.99700
33	.860	9.15		
		9.27		
		9.22		
		9.17		
	.864	9.11		
11:53	.872	9.18		
55		9.15		
57	19.871	9.20		
59		9.14_5		
12^{20}	19.871	9.14_5	42.71	over the past 20' it has been level
25	Insert Bottle		14.70	
30	19.871	9.14_5	14.70	
35	Remove Bottle		42.69	

Sat.

e)

Pos Period f)

{ N.B. with Beck Log N @ 1.85, 2610 did not indicate any increase on the 2 mr/hr scale at the corner hole storage in the corridor }

53 Manually advanced rg to two bells.

55 99.151

Check Calib. of Beck Log N $10^{-11} \rightarrow .95 \times 10^{-11}$

$10^{-8} \rightarrow 1.0 \times 10^{-8}$

N.B.

Checked bottle position selsyn @ 74.00 and string has stretched ~ ½ inch.

Accurate measurement

74.7/16 = top at 74.00

Exp #15

Bottle #24 filled with H_2O 155.856 g

Removed 7 ml H_2O with 5 ml and 2 ml pipette

Add 7 ml U^{233} solution 155.965 g

Rezeroed Bottle at 74.00 inches by moving string on rack drive unit - Dwtn, C.C.

Assume that bottle was centered originally

then displacement of 7/16" ~~or~~ $\Theta = \frac{\pi}{2} \times \frac{7/16"}{10"}$

$= 9.0 \times .4375 = 3.94$

$\cos 4° = 0.9$

4-3-58

Rezeroed ~~Bottle~~ 74.68 selsyn equiv to 74.00

therefore Bottle in will be 14.70+.68 = 15.38

Bottle out will be 42.70+.68 = 43.38

Liq Level @ 99.150

IC-1 Keithley zero shift - use artificial zero .2 to get on scale

IC-2 Beckman zero shift - use artificial zero to get on scale.

#15 ~~3-2~~ 4-3-58 Durm R.g.

	Liq Level	Tad adder	Bottle	Temp		
	99.151	17.14				
140	Start adm.				Safety @ 22.00	
156	17.927	~~22.00~~ .06	42.37	.99655		
223	approx crit					
24	19.871	12.14 ↓ 12.00 ↓ 11.80 ↓ 11.89 ↓ 11.83	42.37	.9968$_0$		a
253	19.876	11.83	~~42.37~~ ~~15.38~~ ↓ 15.38			
57					pos period	b
310	19.876	11.83	42.38	.99714		c
318	19.661	0.06	42.38		neg. Period to reduce Rxns 2 subs	
325	19.869	11.825	42.38			
349	19.880	11.95	42.38	~~.9975~~ .99742	level for part 151	d
353	19.881	11.95	~~15.38~~			e)
411	19.882	11.95	~~42.38~~			f)

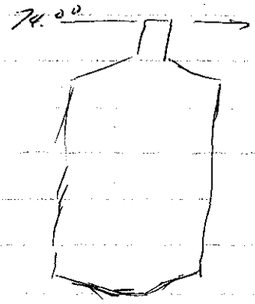
Dump aerem.

4-7-58

Sample	Reg No	Gross Wt	Tare
1	354 918	102.932	21.6
2	354 917	79.396$_4$	20
3	354 916	79.713$_3$	20

4-7-58

Replaced Nylon cord on Bottle rack drive with phosphor Bronze cable. Zeroed @ ~~74.00~~ = 74.00.



~~design~~ ~~water level~~ @ 43.32 for complete submergence of bottles. Hence water level at 43.32 (Orig filling to ~44")

Liquid level reading 99.156 changed balance to zero at 99.150

#16 to check react of 7ml VO_2^{2+} (VO_2)$_2$ in bottle

	Liq Level	Tad Adder	Bottle	Temp		
	99.151	17.14	42.67	Safety at 22.02		
	17.756$_5$	17.14 ↓ .05$_5$				
	17.956$_0$					
215 pm	19.887	13.87 ↓ 13.96	42.67	~.9996$_5$		
	19.906	14.06 ↓ 13.95				
220	19.892	13.90 ↓				
35	19.894	13.84				
45		13.80				
51	19.890	13.73 ↓ 13.66				
300	19.890	13.71 ↓				
311	19.891	13.76				
320	19.891	13.76	42.67 ↓	.9999$_0$	Level for 10'	a)
325	"	"	14.70		Pos. Period	b)

	Liq Level	Tad Adder	Bottle	Temp	
3[34]	19.892	13.76	42.69		Subcrit. c)
	19.650	↓ .06			
3[56]	19.906	13.79	42.69		d)
4[02]	19.905	13.74	42.69		
	903	.68			
		.61			System seems very unstable.
	19.900	.55			

Shutdown for the day.

4[26] 99.150

4-8-58 Tad adder zero at 99.145
Changed to read 99.150
Checked Bottle zero. at 74.07 @ 74.00 height

Exp. #17 April 8, 1958 Durm C.C. RG.
Purpose: Check React. of 7mc of U^{233} sol. in Bottle #24, To check effect of moving bottle small displacements about the mid position 14.78
Safety @ 22.02

	Liq Level	Tad Adder	Bottle	Temp		Comments	
9[55]	99.150	17.14	42.64				
10[04]	17.669	17.14	42.64				
	17.367	↓ .055					
	.302	17.08					
10[16]	(Source out)	9.64					
		↓ 9.44					
		↓ 9.26					
20		↓ 8.98					
22	19.832	8.80				Check Rod Vs Log N calib.	
27	19.835	8.90					
31	19.850	9.01			.99851		
37	19.849	8.96					
42		8.93					
50	19.838	8.93	42.64		.99881	Log N: .1	Level ~ 8' a)
54 58	19.838	8.93	↓ 14.795				+ Period b)
11.01 10	19.838	8.93	42.65				c)
	.840	8.93	42.65				
11		↓ .06					
17	19.680	.06	42.65				- Rg period d)
23	19.845	8.74	42.65			Log N: .1	Level e)
33	19.845	8.74					

	Liq. Level	Tad Adder	Bottle	Temp.		
11 37 AM	19.845	8.74	14.765	0.99875	Pos Period	f)
+2			↓			
45	19.843	8.74	42.685		~ level (Log N = 3.2	g)
55						
	Level with Bottle in		14.765			
1203		2.51				
06		2.63				
12	19.731	2.63	14.775			
			↓		level for 5'	h)
			14.26			
			↓		long Neg Period	i)
19			14.77		long Neg Period	j)
28			↓			
			15.25		level	k)
			↓			
35			15.76		pos Period	l)
			↓			
42	19.731	2.63	16.25		pos Period	m)
			↓			
12 48	19.730	2.63	16.76		pos Period	n)
			↓			
54			17.28		" "	o)

Noted that the cable had jumped the pulley.

Set Beckman Meter trip to .71

EMP #8 Purpose: To check Bottle Displacements from Mid plane

Drwn c.c. RG.

	Liq Level	Tad Adder	Bottle			
1 50	99.154	17.14	14.76			
2 15	Source out					
2 25	19.815	17.14	14.76		+ Period to get	
2 27		11.58	14.76		to ~ .6 on log N	
		↓ 11.52				
	19.700	↓ 11.45				
		↓ 11.38				
2 39	19.695	11.33	14.76		level Crit for ~ 5'	a)
2 37 / 2 46		"	↓ 14.26			b)
2 46 / 2 52		"	↓ 14.78			c)
2 52 / 2 58	19.696	"	↓ 15.275	.99972		d)
2 58 / 3 05		"	14.78			e)
	Level with bottle.					
3 06			13.76			f)
3 11			↓			
3 14			15.78			g)
			↓			
3 16 / 3 21			16.13			h)
			↓			
21 / 26			16.54		Nearly level	i)
26 / 31	19.696		13.53		" "	j)

∴ Center of reactivity is at 15.00

3 31 Scram

99.152

4 ML U^{233}

Exp #19. Dwn C.C.

H_2O in Bottle #24 gross 151.865 g.

added 4ml U^{233} soln 155.998 g.

Rezeroed Bottle 74.00 = 74.00.

(Read 74.10 changed reading to 74.00) Safety & 22.01

	Lig. Level	Tab Added	Bottle	Temp		
10 45	99.151	17.14	42.59			
11 00	Low TA *	.06				
02	17.676	.06	42.59			Blog N ~ 0.01
11 08	Source out.					
09		7.62				Blog N ~ 0.1
		↓ 7.31				
		↓ 6.98				During some adn than feed Value
12	19.821	8.68				
		↓ 8.80				
		↓ 8.99				
		↓ 9.26				
		9.39				
		↓ 9.52				
		↓ 9.46				
11 19	19.821	↓ 9.38				Check B log N Calib.
11 36	19.821	9.38	42.59	.99741		Slightly Sub over past 15' a)
40	.820	9.38	↓ 14.70			Pos Period b)
50	.820	9.38	↓ 42.59			Slightly neg. period c)
12 01	19.660	↓ 06				Neg Period d)
12 12	19.8	9.38				
		↓ 9.31				
12 22		9.25				
		↓ 9.16				
12 26	19.815	↓ 9.20				
		↓ 9.25				
30		↓ 9.23				
42	19.820	↓ 9.29	42.59	.99738		Level e)
55						or slightly sub.

	Lig Level	Tad Adder	Bottle	Temp.		
12[59]	19.819	9.29	14.705		Pos Period	f)
1[07]	19.820	9.29	42.60		Level Sub	g)
	19.661	.06			Neg period	h)
		9.29			level ~0.3 Blog N	
		9.31				
1 47pm	19.832	9.31	42.60	15'	Sub critical slight	i)
	19.834	9.31	14.71	.99743	Pos Period	j)
~~2 01~~		Checked Calib of Beck log N			before moving bottle	
2[01]	19.833	9.31	42.60			
2[08]	19.833	9.31	42.60		Slight Pos Period	k)
2[16]	19.661	.06	[illegible] 42.60		Neg Period	l)
20	19.826	9.27	42.60		Level Very Low	m)
			14.71		Pos. Period	n)
44	19.825	9.27	42.60	.99743	lnN = 8.2	o)
3.57	19.824	9.27	42.60			

(N.B. 2610 read 5 mr at ~~top~~ of concrete bunker ~ 4-6 ft from vehicle gate R.P.o.
Middle of corridor 2½ mr/hr
2' from door 7 mr/hr
The 2610 inst was discovered to be practically dead, hence the above readings are in error.)

4-10-58 EXP #20 Repeat Bottle Zero
DWM
C.C.
For effect of phosphor bronze cable.
Bottle #24 filled with H_2O 155.
Bottle zero checked OK Safety @ 22.01

	Lig Level	Tad Adder	Bottle	Temp		
10[50]	99.151	17.14	42.61			
10[55]	~10.3					
58	17.574	17.14	42.61		Blog N = .0075	
11[00]	(18.308)	17.14			Blog N = .	
	(18.011)	.06				
1[07]	19.816	10.38	42.61		Def. Sub crit.	
		10.41				
25	19.818	10.41	42.61	.99744		
31		10.35				
		10.30				
		10.23				
11.51	19.816	10.23	42.61	.99748		a
	11	11	14.70		for Period	b
12.08	11	11	42.72	.99758		c
12.15	bottle chain off Pulley				Shut down	

		Source		Beckman	IC3 IC2	
1:37			i12	seen on		Safety 22.04
12:45	5.5	17.16	42.72			
12.48	14.336	17.16	42.72			
107		9.55				Source Out Blog N = 0.09
		9.24				
		8.94				
111		8.64	42.72			
		8.58				
		8.52				
		8.41				
139	19.830	8.33				
141	19.823	8.21	42.72	.99940		Lig N ~0.1

#20 (Cont.)

	Lig Level	Tad adder	Bottle		
	19.820	7.93	42.72	(.9994)	
		7.80			
		7.91			
		7.97			
	19.8	7.94	42.72		
		7.885			
240	19.821	7.82	42.72	.99925	Critical a)
	Bottle to center of Reactor log N calibration OK				
245	19.822	7.82	14.71		Pos Period b)
	Bottle Removed				
300	19.822	7.82	42.70		Critical c)
305	Tad adder covered				
310	19.688	.06	42.70		Neg Period d)
311	Tad adder raised				
		7.76			
		↓			
		7.62			
324	19.816	7.62	42.70		Slight Sub c)
		Bottle In	↓		
	19.816	7.62	14.71	.99915	Pos. Per. f)
		Bottle Out	42.72		
352	19.816	7.62	42.72		Sub Crit) g)
	Dump solution & Shut down				

Exp #21 DWM @ C.

Bottle with H_2O Repeat of #20 (where data was poor) Safety 22.00

	Lig Level	Tad adder	Bottle	Temp	
	99.152	17.14	42.69		
1020	18.167	17.14	42.69		
	17.860	↓ .06			
1027	19.912	10.52	42.69		Source out + Period
	Drop level thru feed valve Pumps off.				
31	19.826	11.28			
		↓			
		11.20			
		11.10			
		11.15			
		11.175			
1107	19.823	11.175	42.69		BLog N ≈ 0.24 Calibration OK
	Insert Bottle.				→ level for 10' at least a)
1107 1122	19.823	11.175	14.71 ↓		Pos. Period b)
1138	19.823	11.175	42.695	.99901	Slightly Sub c

Super Crit.
Sub Crit
"
"

R.D. Parker surveyed for radiation B Ln N 0.27

Corridor 1 mr/hr

Glass door in corridor 4 mr/hr

Outside Vehicle Gate ~~Reactor door Control Blocks~~ 1 mr/hr

Remove Bottle.

42	19.626	10.06	42.695	Neg Period ~~Slightly Sub~~ d)
47	~~Neg Period~~	11.18		e)
	19.827	~~42.69~~ ↓ 11.22	4x2.695	
	19.825			level for 10' f)
1200	Insert Bottle			
	19.826	11.22	14.71	g)

Exp #21 (Cont)

	Liq Level	Tad Adder	Bottle	Temp	
	Remove Bottle				
	19.825	11.22	42.71	9991s Approx Level	h)
12[28]	Lower Tad Adder				
	19.626	.06	42.71	Neg Period	i)
32	Raise Tad Adder				
	19.830	11.26,5	42.71	Slightly Pos	j)
57	Insert Bottle				
	19.829,5	11.26,5	14.71	Pos Per.	k)
	Remove Bottle				
	"	"	72.25	Level	l)
125	Pump Solu - Calibration-log N				TK
136	99.152				

4-15-58

EXP #22 Added 120.0 mg of Std H_3BO_3 (Argonne) to the H_2O in #24 Bottle.

Gross Wt .8963
Tare .7763
Net H_3BO_3 .1200 g

Time	Lig. Level	Tad Adder	Bottle Temp		
	99.150	17.14	42.69	Safety at 22.00	
10 02	Start Solution into reactor			Rezero Bottle 74.09 → 73.99	
10	17.574	17.14		by changing selsyn 0.1	
13	17.272	.06			
23	Source out				
25	19.805	8.22			
		8.09			
		7.99			
		7.88			
	19.800	7.75	42.69	crit for ~7'	a)
10 42	Insert Bottle				
11 00	19.802	7.75	14.71	Positive Period ~20'	b)
11 03	Remove Bottle				
	19.802	7.75	42.69	.99885 Approx Level (.72)	c)
11:22	Insert Bottle				
	19.803	7.75	14.70	Positive Period	d)
11:50	Remove Bottle				
	19.805	7.75	42.69	.99885 Approx Level (2.1) (Subcrit)	e)
12:08	Lower Tad Adder to decrease power.				
	19.660	.06	42.69	Neg Period	f)
12:13 16	Raise Tad Adder				
	19.813	7.76	42.69	Level	g)
12 35	Insert Bottle				
	19.813	7.76	14.70	Pos Period	h)
1259	Remove Bottle				

Exp 22 (Cont.)

	Liq Level	Tad Adder	Bottle	Temp		
	19.813	7.76	42.71	.99385	~Level (Sub) 0.8	i)
1[15] PM	Insert Bottle.					
	19.813	7.76	14.69		Pos Period	j)
41	Remove Bottle					
	19.8	7.76	42.71	.99930	~Level (Sub) (2.0)	k)
1[56] PM	Dump Soln					
	B Log N Check Calibr OK.					

#23 4-15-58 Dwn CC.

Added 0.1867 gm H_3BO_3 to sample
#22 .1200
Total 0.3067 g H_3BO_3 in Sample #24

	Liq Level	Tad Adder	Bottle	Temp	
	99.150	17.14	42.72		Safety @ 22.02 Bottle zero 43.96
9[25]	Start feeding solution				
32	17.875 ↓ 17.562	17.14 ↓ .06	42.72		B Log N = .01
	"	"	↓ 14.69		Doubtful if there was any Mult. change upon inserting bottle.
9[47] 48	Source Out	10.92 ↓ 10.69 ↓ .56 ↓ .40 ↓ .46			
9[58]					
10[05]	19.856	10.40[5]	14.69		Back Log N calibration OK
10[16]	19.856	10.405	14.69		Level for 10' .1 a)
16	Remove Bottle				
	19.856	10.405	42.67		Positive Period b)
27½	Insert Bottle				
			14.67		~Level for 11' (1.0) c)
	19.855	10.405	14.67		
47	Lower Tad Adder				
	19.6~	.06	14.67		Neg Period d)
50	Raise Tad Adder				
	19.859	10.36	14.67	.99960	~~Level~~ Slightly Positive ⇒
	19.857	↓ 10.28	14.67		Level 6' Inc. 3 e)

	Liq Level	Tad Adder	Bottle	Temp	
11[14]	Remove Bottle.				
	19.857	10.28	42.68[+]	Positive Period	f)
11[25]	~~Remove~~ Insert Bottle			check Calibration OK	
~~1148~~	19.857	10.28	14.70	~ level	g)
11[44]	Lower Tad Adder				
	19.673	.06	14.70	Neg Period	h)
	Scrammed by changing range on Beckman after bypassing Keithley				

9-15-58 Dilute e e-

#2~~4~~

#24 Bottle with .3067 g H_3BO_3

	Liq Level	Tad Adder	Bottle	Temp		
	99.152	17.14	14.70		Safety @ 22.02	
	Start adding soln	.06				
12[58]	19.681 Pump	~~Pump~~				
1[02]	Source	Out				
1[05]	19.861	9.01 ↓ 8.95 8.89	14.70	1.0001,		
1[30]	19.858	8.78	14.70	~ level (Slight +)		a)
1[32]	Remove Bottle					
	19.857	8.78	42.68		Pos. Per.	b)
1:42	Insert Bottle					
	19.858	8.78	14.69		large ~~Slight~~ Pos Per. Not Level	c)
1[54]	lower Tad Adder	↓				
	19.704	.06	14.69	.9998,	Neg Per	d)
2[00]	Raise Tad Adder	8.52				
	19.859	8.42	14.69		Level	e)
2[15]	Remove Bottle					
	19.859	8.42	42.67		Pos Per.	f)
2[24]	Insert Bottle					
	19.859	8.42	14.68			g)

Check Calibration 10^{-11} = $.90^{-} \times 10^{-11}$ on Recorder

10^{-8} = $.90^{+} \times 10^{-8}$

2[43]	Remove Bottle and Cover solution to level				
	19.7	5.62	42.71		h)
	19.79	5.68	42.71		
	19.794	5.62	42.71	~ level for (Slight Pos)	h)

#24 Cont

	Liq level	Tad Adder	Bottle	Temp	
	19.793	5.62	42.71	.99975	approx h)
3:00 pm		More Bottle into reactr			level for 10'
3:05	19.793	5.62	14.68		Neg Period i)
3:15		Remove Bottle			
	19.793	5.62	42.72		level (+) j)
		Insert Bottle, Raise Tad Adder to maintain level)			
		8.31	14.68		
		8.21			
		8.26			k)
		8.32			
	19.846		14.68		level (−) ~~k~~
3:46		Remove Bottle			
	19.848	8.32	42.71		Pos Per l)
~4:00		Insert Bottle			
	19.~~84~~[50]	8.32	14.68		m)
4:06	~~Level with~~	Remove Bottle	lower ~~Set~~	Tad Adder to level.	
	19.798	5.52	42.70		level n)
		Insert Bottle ~~14.70~~			
	19.795	5.52	14.70		neg Period o)
4:32		Remove Bottle			
	19.795	5.52	42.71		p)
4:39		Dump solution.			

4-16-58

#25

Bottle gross weight 155.869 with H_3BO_3

Added Std Boron .201$_3$ g H_3BO_3

Bottle zero OK 79.00 = 7900

	Liq Level	Tad Adder	Bottle	Temp	
	99.153	17.14	42.66		Safety at 22.02 Source in
12:45	Start Pumping solution				
12:52	~ 9.2				
1:07	Source out.				
1:13	Inserted bottle to stop rising period				
1:15	19.829	~~7.14~~ 9.74	14.69		approx level (± .2)
	Raise power by Removing Bottle				
1:25	19.828	~~7.1~~ 9.74	42.71		
	Raise Tad Adder				
		13.05			
	Lower Tad Adder				
		9.47			
		↓			
		1.27			
		↓			
	19.813	8.99	42.71	.9999$_2$	Pos Per. a)
1:43	Insert bottle		↓		
	19.812	8.99	14.71		Neg Per. b)
1:58	Remove Bottle		↓		
			42.70		Pos. Per c)
~~2:03~~ 2:08	Insert Bottle		↓		
			14.68	.99986	Neg. Per d)
	Check Calibration of Range ok				
2:26	Remove Bottle		42.71		Pos Per e)
2:36+	Insert Bottle		↓		
			14.72		Neg Per f)
2:57	Remove Bottle		↓		
			42.72		Pos Per g)

Shut down by allowing power to increase until Beckman meter trip is actuated at 0.85 Recorder ~~2.10~~ 10.0.

Analytical Data Report Sheet 24809

U^{233}	26.7 mg/gm soln	1.052 gm/ml	
U^{235}	19.7 mg/gm soln	1.028 gm/ml	

U-233 Sample before dilution ~18 ml

U = 187 g/l

UD-12

3 CUC-300

U-233	98.06
U-234	1.73
U-238	0.21

Al	928 ppm
Cu	2
Mg	6
Fe	0

Thorium 0.002 gm/liter

19.81 / 19.66

Added .0984 g H_3BO_3 To #25 run

.2013

.2997 g H_3BO_3 in #24 bottle for Run #26

EXPERIMENT #26 - - - Slo Jr. C C. R.G.

4-18-58

	Lig. Level	Rod Adder	Bottle	Temp	Remarks
	99.151	17.16	42.70		Safety @ 20.01
12 47 PM	Start Solution				
		0.06			
1 12	+ Period error out				
	19.881	9.05	42.70		
1 17	Start to level by lowering T.A.				
1 23	19.819	6.27	42.70	1.00125	Very close to level.
		6.22			
		6.18			
		6.00			
1 35	19.814	5.95			
		5.82			
		5.74			
		5.63			
	Start Positive ↓ Period.				
1 54	19.839+	7.12	42.70	1.00109	Pos Period a)
2 08	Start Bottle in				
	19.837	7.12	14.69		Neg Period b)
2 27	Start Bottle out. Log N Calib OK				
	19.838	7.12	42.69		Pos Period c)
2 39	start Bottle in.				
	19.837	7.12	14.71		Neg Period d)

Evidence that reacta has drifted v/l on more

	Liq Level	Tad adder	Bottle	Temp	
3 51	Lower Tad Adder ~ ½"			for new Neg Period	
~~3 51~~	19.823	6.62	14.71	1.00096	Neg Per e)
3 01	Remove Bottle				
	19.824	6.62	42.73		Pos Per f)
3 16	Insert Bottle				
	19.825	6.62	14.70		Neg Per. g)
3 35	Remove Bottle				
	19.824	6.62	42.70		Pos Per h)
3 49	Insert Bottle				
	19.826	6.62	14.705		Neg Per i)
4 10	Remove Bottle				
	19.825	6.62	42.71	1.00084	Pos Per j)

Set Keithley Meter scram set point to 3[illegible] to shut down with meter scram.

4 31 99.151

#27 April 21, 1958 Dwn cc

II 24 Bottle filled with 145.875 g H_2O

Add 10 ml UO_2F_2 solution

	Liq. Level	Tad Adder	Bottle		
	99.146	17.14	73.98		Safety @ 22.00 (Changed setpoint from 74.08)
10 12	Start Soln in system.		42.74		
10 53	17.750	.06			
10 56	Source Out				
	19.766	5.37	42.71	.99935	
	759	5.28			
		5.20			
		5.06			
	19.661	.06			Fairly stable Neg Period (Control not used) a)
11 17	Insert Bottle				
	19.661	.06	14.71	.99926	~~Positive Period~~ too slow b)
	19.695	1.50	14.71		~~Neg Period~~ + Period c)
	Remove Bottle				
			42.66		Neg Per d)
11 48	Insert Bottle Check Rck log N Calib OK				
	19.685	1.50	14.71		Pos Period e)
12 00½	Remove Bottle				
	19.696	1.50	42.66		Neg Period f)
12 16	Insert Bottle				
	19.691	1.50	14.71	.99898	Pos. Period g)
12 27	Remove Bottle				
			42.74		Neg Period h)
12 44	Insert Bottle				
	~~19.69~~ 19.701	150	14.71		Pos Period i

	Liq Level	Tad Adder	Bottle	Temp.	
~~12:54~~ ~~11.446~~	Remove Bottle.				
	19.700	1.50	42.76	.99891	Neg Period j)
112	Start to level with Tad Adder				
120	19.758	4.52 ↓ 4.46 ↓ 4.40 ↓ 4.47	42.76		approx level
	19.750		42.76		level (slightly sub) → k)
147	Insert Bottle				
	19.750	4.47	14.70		Pos. Period l)
156	Remove Bottle				
	19.750	4.47	42.73	.99875	Level m)
	Check Calibration OK.				
208	Dump some solution thru feed valve & lower Tad Adder				
	19.585	0.06	42.73		Neg Period n)
214	Start to level with Tad Adder				
	19.757	9.04 ↓ 8.99 ↓ 8.87	42.73		
	19.748	8.92			Level o)
300	Start Bottle in				
	19.748	8.92	14.70		Pos Period p)
	Change in range on Keithley, tripped meter				
	Shut down				
	99.150				

April 22, 1958

#28 Down C.C.R.G.

~~Liq Level~~ Gross Bottle #24 weight with H_2O 150.874 g

Add 5 ml UO_2F_2 solution

	Liq. Level	Tad Adder	Bottle	Temp	
	99.150	17.14	42.70		Bottle Zero 7399
10.25	Start adding solution				
1107	Source out				Back log N ~ 0.22
04	19.746	7.32 ↓ 7.17 ↓ 7.04	42.70	.99907	Nearly level,
	19.728		42.70	.99900	8' level (.22) @
1130	Insert Bottle				
	19.728	7.04	14.72		Pos Period b)
1146	Remove Bottle				
	19.728	7.04	42.69		slight Pos level c)
1200		0.06			to reduce Power
1205	19.731 ↓ 7284	7.04	42.69		Positive
12.20	19.727	6.86	42.69	.99866	
1:00	19.724+	6.61	42.69 ↓ 14.71 ↓ 42.69		level d) Pos Period d)' slightly neg e)
1.24	19.705	4.61	42.69	.99866	Neg Period f)
1.46	Insert Bottle				Check Calib of Back log N - agrees a little on idle
	19.703	4.61	14.71		Pos Period g)
158	Remove Bottle				
	19.704	4.61	42.69		Neg Period h)

#28 (Cont.)

Lig. Level Tad Adder Bottle

2:18 Insert Bottle

19.703 4.61 14.69 Pos Period i)

2:29 Remove Bottle

19.704 4.61 42.70 Neg Period j)

2:47 Insert Bottle

19.703 4.61 14.70 Pos Period k)

2:58 Remove Bottle

19.702 4.61 #2.13 .99848 Neg Period l)

Checked Log N calib ok after shutdown by dumping sol.

29 Dwm 00 #28 Dwm R.G CC

Gross Bottle #24 Weight With H_2O 150.874

Add 5 Ml UO_2F_2 2.35- Solution

	Lig Level	Tad Adder	Bottle Temp	Safety	
		17.14	42.71	22.00	
8:45 AM	Start Adding	Solution			
9:50 AM	Source out	6.91 6.85- 6.76			
10:20	19.735	6.45	42.71	1.00060	Log N Calib OK
10:40	19.734 Insert Bottle	6.52	42.71		(a)
	19.735	6.52	14.70		Pos Period b)
10 54	Remove Bottle				
	~19.735	6.52	42.70		c)

	Lig Level	Tad Adder	Bottle Temp		
11 06	Lower Tad adder				
	19.613	.06	42.70	Neg Period	d)
	Raise Tad Adder				
	19.731	6.23	42.70	level	e)
11 41	Insert Bottle				
			14.70	P Period	F
11 55	Remove Bottle				
	19.737	6.23	4282	level	G
12 03	19.617	0.06	42 82	reduce Power	H
12 10	19.618	0.06	4282	1.00045	H
12 42	19.741	6.20	4282		I
		~~14.70~~	14.71		J
12:56	19.743	6.20	42.82		k
1:08	19.622	0.06	42.82	reduce Power	l
1:25	19.750	6.22	42.88	adjusting to critical	m
1:38	19.746	6.27	42.88	level 1.00043	m
	19.745	6.27	14.70		n
1:54	19.744	6.27	42.78		o

Run #30 April 24, 1958
20 ml U-235 soln

#30

Bottle #24 130.877 g H_2O + bottle
5.000 gm H_2O
20.000 ml $(H_2O + UO_2F_2)$ soln
155.877

	Liq Level	rad adder	Bottle	
	99.150	17.14	42.70	
10[50]	Start Solution into reactor annulus			
11 09[30]	Sonic Out approx level			
10	19.761	10.06	42.70	
15	.730	9.02	42.70	neg. Period.
20	.731	9.02	42.70	nearly level
25				
35	.733	9.02	42.70	positive.
		8.80		
11 [50]	Lower rad adder			.9996.
11[57]	19.641	3.42	42.70	Negative period ~ 8 ¢
12[03]	Insert bottle.			→ Calib Check ~ Backlog OK
	19.640	3.42	14.71	Pos Period a)
12[19]	Remove Bottle			
	19.641	3.42	42.72	Neg Period b)
12[35]	Insert Bottle		.99918	Calib Check OK
	.639		14.70	Pos Period c)
12[50]	Remove Bottle	Calib Ch. OK		
	.638	3.42	42.72	Neg Period d)
1[06]	Insert Bottle		.99929	
	19.637	3.42	14.71	Pos Period e)
1[20]	Remove Bottle	Calib Check OK		
	19.636	3.42	42.73	Neg Period f)
1[38]	Insert Bottle			
	19.636	3.42	14.70	Pos Period g)

	Liq level	Tab Reader	Bottle		
	19.636	3.42	14.70	Pos Period	g)
1:49	Remove Bottle			Calib Ch OK	
	19.637	3.42	42.69	Neg Period	h)
2:07	Insert Bottle				
	19.637	3.42	14.70	Pos. Period	i)
2:19	Remove Bottle			Calib Ch OK	
	19.637	3.42	42.72	.9990. Neg Period	j)
2:36	Shut down.				

15 ML. U-233 Sol'n
Bottle # 24
#31 140.88 g H_2O 4-25-58
Pipette 15ML U233 Soln. cc, R.G. pump
Source in 8:26
IC1, IC3, IC2

	liquid level	T.A.	Bottle Temp		
9.21 AM	4.28	17.14	42.73		
10.08	19.70 ?	8.60	42.73	.99931	Source out
10.15	19.770	10.70	42.73	Pos. Period for Power level	
10:3k	19.703	7.51	42.73	Pos " " " "	
10:34	19.702	7.40	42.73	Pos " " " "	
10:40		7.34	42.73	Pos " " " "	
10:43		7.21	42.73	Pos " " " "	
10:47	19.699	7.11	42.73	Pos " " " "	
10:58	16.699	7.11	42.73	(.99988 ?) RR 11:48	
11:02		7.02	42.73	Pos Period for Power level	
11:10		6.94	42.73	Pos " " " "	
11:16		6.86	42.73	Pos " " " "	
11:18		6.81	42.73		level
11:33		0.80	42.73 ↓	Neg .99880	Period A
11:48	19.583	0.80	14.71 ↓		+ Period B
12:01	19.585	0.80	42.73 ↓		- Period C
12:14	19.586	0.80	14.72		+ " D
12:29	19.587	0.80	42.78	.99862	- " E
12.42	19.585	0.80	14.70		+ " F
12:54	19.586	0.80	42.80	.99845	- " G
1:07	19.586	0.80	14.70		+ " H
1:23	19.587	0.80	42.83		- " I
1:34	19.586	0.80	14.71	.99837	+ " J
1:43	19.585	0.80	42.82		- " K

Exp #31

1:52 Shut down

EXP #32 4-29-58 D₂Om C.C.

Bottle weight with H_2O 143.877 g

Remove 3 ml H_2O

Add 3 ml conc. Nitric acid

Add 12 ml Pu solution

containing 20.7 mg/ml

	Lig. Level	Tel adder	Bottle	Temp
	99.146	17.14	74.04 ~~Bottle~~	Zero, Safety @ 22.00
9¹⁵	Start solution in to annulus. 14.74			
9³⁰	Moved bottle from 14.74 to 24.7 – not much effect on Mult @ .01			
9⁴²	Source Out	Bottle in.		
	19.503	3.12	14.74	Slightly sub critical Log N 0.2
10⁰⁰	19.504	3.12	14.74	~ Level Log N = 0.185
10¹²	Super – dump some soln then feed valve & raise tel adder			
10¹⁵ 10¹⁹	19.500	5.15 sub crit	14.74	
	19.503	5.29		
10²⁵	19.504	5.45		
10³²		5.36		
10⁴⁰	Remove Bottle	26.27		Critical Neg Period ≈ 15.5¢
10⁴⁵	Insert Bottle	11.02	14.73	Moved Tel adder
	19.605	11.02	14.73 .99806	Pos Period a)
11⁰⁰	Remove Bottle			
		11.02	42.7	b)

Discovered wire off the pulley.
Evidence on period chart that it was off during positive period

Insert safety blade in order to put wire back on pulley.

Insert source start ☆ remove blade

11⁰⁰ 27 PM	Log N .03	7.16			
11⁰⁴⁰	Safety @ 22.00	Source out	On neg Period		
11⁰⁴⁴	Insert ~~Bottle~~ start	Pos Period.			
	Lig Level	Tel Adder	Bottle	Temp	
	19.626	11.02	14.74		Pos Period c)
11⁵⁰	Remove ~~Bottle~~	Check P. Log N Calib OK			
	19.625	11.02	42.74	.99785	Neg Period d)
12⁰⁷	Insert Bottle	B. Log N Calib OK			
	19.625	11.02	14.73		Pos Period e)
12¹⁷	Remove Bottle				
	19.626	11.02	42.77		Neg Period f)
12³⁴	Insert Bottle	B. Log N Calib OK			
	19.624	11.02	14.74	.99785	Pos Period g)
12⁴⁵	Remove ~~Bottle~~				
	19.623	11.02	42.77		Neg Period h)
1⁰⁰ PM	Insert Bottle	B. Log N Calib OK			
	19.622	11.02	14.74		Pos. Period i)
1¹⁰	Remove Bottle				
	19.622	11.02	42.77		Neg Period j)
1²⁷	Insert Bottle	Back Log N Calib OK			
	19.624	11.02	14.72		Pos. Period k)
1³⁶	Remove Bottle				
	19.62	11.02	42.73	.99759	Neg Period l)

	Liq Level	Tot Adder	Bottle	
	Insert Bottle			→ Pos Per. (n, ϕ)
	19.625	11.02	14.73	
2:04 PM	Remove Bottle			→ Neg Per. (n, ϕ)
	19.624	11.02	42.75	.99760
2:19	Shut down	Exp # 32		

Exp. # 33 5-5-58

The purpose of this exp. is to measure the fission produced activity in U^{235} foils bare and Cd. covered in the fuel region and in the central H_2O region.

R.R. & C.C.

	Liquid level, inches	T.A. inches	Temp.
2:05 PM	source in	, IC2, IC1, IC3 (not inching)	
2:23	10:47	17.29	
2:32	17.104	17.29	.99742
2:50	19.340	17.29	# Photo Multiplier seems sick
3:03	18.946	7.72	~ + Period
3:03	19.993	9.65	+ Period for Power
3:23	19.959	start to level	
3:25	19.929	5.96	.99758 ~ level
3:40	Shut down Exp # 33		

Exp # 34 5-13-58

Re-run of Exp. # 32

Pu soln. in bottle

C.C., RL

A 2 Pen recorder is being used for Inst Beckman Oak Ridge

	Liquid level	T.A.	Bottle Temp	
10:25 AM	Source in	Response	IC-1	IC-2
			Beckman log	
10:30	Insert	Bottle		
		17.14	14.71	
10:43	16.08	17.14	14.71	.99785
10:53	18.40	.06	14.71	
11:25	19.350	.06	14.71	
11:30	19.438	~~.23~~ .91	14.71	.9976
11:40	Shut down Rack on bottle caught on wood~~ed~~ board resulting in severe bending of the rack and made shut down mandatory.			

Rack repaired at 4-12 5-14-58

System readjusted

Exp # 35 5-15-58

Re-run of Exp. # 32 Pu. soln 20.7 g/l in bottle

CC, RG

Two pen recorder being used to record period for ORNL + BECKMAN lin. both.

Blade 22.09"

	Source in	Inst Response	IC-1, IC-2, log Beckman	
10:30AM	Liq level	T.A.	Bottle	temp
10:33	99.158	17.14	14.70	
	Screw apparently fast Keithley			
	continue operation with test		11 b/ passed	
10:47	99.158	17.14	14.70	Safety 2209
11:21	19.190	17.14	14.70	.9987
11:27	19.349	00.06	14.70	.9984
11:49	Source out slightly Pos			
	19.463	5.34	14.70	
12 53	19.439	4.45	14.70	.9979
	(APProx)	Critical		
1:02	19.564	10.46	14.70	Pos Period A
	"	"	42.73	Neg " B
	"	"	14.72	Pos " C
1:38	"	"	14.72	.9977
	"	"	42.71	Neg " d
	"	"	14.69	Pos " E
	"	"	42.74	Neg " F
2:26	"	"	14.70	Pos " G
2:39	"	"	42.74	Neg " H
2:54 PM	Shut Down Exp # 35		temp .9974	

5-16-58 Exp # 36

Re-Run of # 35 And # 32

Pu Soln 20.7 m.g. Bottle c.c. R.G.

10:40 AM Blade 22.02"

Source IN – Inst Response Ic-1, Ic-2, log Beckman

	liq level	tA	Bottle temp	
10:43	99.159	17.14	14.70	
	Fast Keithley still Defective			
11:16	18.024	.06	14.70	.9974
11:32	19.300	.06	14.70	.99725
11:36	19.335	.06	14.70	Pump off
12:12	19.439	5.50	14.70	
12:34	19.435	5.20	14.70	.996896 → .996960
1:00	19.435	5.20	14.70	
	Approx Critical			
1:02	19.537	10.62	14.70	Pos Period A
	"	"	42.75	Neg " B
	"	"	14.71	Pos " C
	"	"	42.75	Neg " D
	"	"	14.69	Pos " E
	"	"	42.75	Neg " F
5-16-58	Bottle Center was Approx 1/8" off (Adjustment Made)			
2:25 PM	"	"	14.70	Pos " G
	"	"	42.75	Neg " H
2:51 PM	Scram on Period – When log Beckman Adjustment was being Made			

5-19-58

Solution level in sight glass = 21.5" → 58.6 l

No reading was found in log book of previous level in storage tank, but if memory serves me correctly it was @ 22.0 in.

If one takes the reading of exp # 2 p 13, 20 3/8 in and adds 5.2 l to 56 l one gets 22 1/4 in as the original liquid level in the storage tank. Hence evaporation has lowered the level 0.75 in. in 2 months 3-19 to 5-19. Total evaporation

2.75 l/in x .75 = 2.06 l or 1 l/month

D Magnuson

5-19-58 C.C. D.W. RR

Exp #37 Pu Soln. in bottle

Weight 146.88 g H_2O + bottle

add 3.00 ML Conc. Nitric

add 6.00 ML Pu Soln ~20.7 g/L

11:25 AM blade 22.01"

Source in Inst Response IC-1, IC-2, IC-3

	lig level	+A	Bottle	temp		
11:34	99.156	17.16	42.71			
11:49	14.321	17.16	42.71			
12:07	19.226	7.14	42.71	.99696		
12:10	19.556	7.14	Source out ~ sub.			
12:15	Power failure → scram					
12.20	Source in. start up again.					
~12:48	Source out.					
	19.597	Sub critical				
12 55	19.629	9.92	42.71	1.00199	+ period. To raise power level.	
1 "	19.597	8.09 ↓ 7.95				
15	19.592	7.80				
18		7.63				
25	19.585	7.48		1.00094		
30		7.35				
37	19.579	7.17				
1:46	19.579	7.03				
1:58	19.575	6.86				
2:15	19.570	6.70				
2:42	19.572	6.60				
2:54	19.572	6.60	~42.71 level ↓ 14.7	.99996	A	

Bottle wire jumped Pulley

3:02	Blade inserted to enter the room				
3:11	Blade out sub - source in				
	lig. level	T.A.	Bottle		
3:12	19.578	6.60	out		
3:21	19.459	0.06	14.7 ↓ ~ critical		
3:27	19.519	3.26	14.71	.99958	B
3:41	19.512	3.26	42.70	Neg Period	C
3:45	19.512	3.26	42.74	"	
3:58	19.512	3.26	14.67	Pos "	D
4:13	19.512	3.26	42.75	Neg "	E
4:30	Shut Down Exp. #37				

5-20-58

Exp # 38 Remn of Exp # 37 R.B. Dwm C.C
Pu Soln in Bottle
Weight 146.88 g H_2O + Bottle
Add 3.00 ml Conc Nitric
Add 6.00 ml Pu Soln ~ 20.7 g/l

9:18 AM	Safety Blade	22.04			
	liq level	ta	Bottle	temp	
	99.155	17.14	42.70		
9:30	Source in - Inst Response IC-1, IC-2, IC-3				
9:51	18.021	0.06	42.70	.99785	
10:03	Source	out	Sub Critical		
	19.556	1.76	42.70		
10:30	19.567	2.81	42.70	.99765	
10:49	19.570	3.38	42.70	~ level	
11:55	19.558	5.15	42.70	approx level	A
12:01	19.558	5.15	14.73	Pos Period	B
12:10	19.558	5.15	42.73	level	C
12:15	19.465	0.06	42.73	Neg Period	D
12:27	19.570	5.15	42.73	level	E
12:43	19.554	5.11	42.73	"	
12:47	19.555	5.13	42.73	"	
12:51	19.555	5.15	42.73	"	
12:57	19.558	5.22	42.73	"	
12:59	19.559	5.17	42.73	"	
1:13	19.559	5.15	42.73	"	
1:18	19.556	5.11	42.73	"	
1:26	19.555	5.13	42.73	"	
1:30	19.495	1.78	14.72	Pos Period	F

	liq level	t.A.	Bottle	temp		
1:52	19.495	1.78	42.75		Neg Period	G
2:10	19.495	1.78	14.68	.9970	Pos "	H
2:29	19.495	1.78	42.74		Neg "	I
2:47	19.495	1.78	14.73		Pos "	J
3:04	19.495	1.78	42.74		Neg "	K
3:15 PM	Shut Down Exp # 38					

5-22-58

Exp # 39

152.879 H_2O + 3 Ml ACS Nitric

Safety Blade 22.04"

Source in - Inst Response IC-1, IC-2, IC-3

	liq level	ΔA	Bottle	temp	
9:35 AM					1:49
9:37	99.155	17.14	42.68		2:03
10:03	19.431	0.06	42.68	.99765	2:17
10:10	Source out		Approx. Critical		2:40
	19.575	6.58	42.68		3:03
10:30	19.558	6.30	42.68		3:23
10:32	19.557	6.22	42.68		3:47
10:35	19.554	6.13	42.68		3:54
10:40	19.551	6.01	42.68		3:57
10:42	19.547	5.92	42.68	.99735	3:59
10:53	19.546	5.84	42.68		4:01
11:00	19.540	5.60	42.68		4:07
11:26		5.55	42.68	.99735	4:11
11:41		5.49	42.68		
11:55	19.539	5.49	42.68	Approx level/ ~~Pos Period A~~	
12:00	19.538	5.49	14.72	.9970 Pos Period A	
12:14		5.49	42.75	level/ ~~Neg "~~ → B	
12:22		0.06	42.75	Neg " C	
12:33		5.55	42.75	leveling	
12:37		5.49	42.75	leveling	
12:52	19.542	5.44	42.75	leveling	
12:57		5.39	42.75	"	
1:15		5.46	42.75	" D	
1:26	19.547	5.49	42.75	" .9968	

5-22-58

Cont — Exp # 39

liq level	ΔA	Bottle	temp		
19.546	5.49	14.71		Pos Period	E
19.547	5.49	42.74		level	F
19.515	3.47	42.74		Neg Period	G
19.515	3.47	14.68		Pos "	H
19.515	3.47	42.73		Neg "	I
19.515	3.47	14.69	.99655	Pos "	J
19.566	5.49	42.80			
19.563	5.43	42.80			
19.561	5.38	42.80			
19.559	5.33	42.80			
19.557	5.26	42.80			
19.557	5.26	42.80	level/ Just critical		
Shut Down Exp # 39			.99655		

5-23-58

Exp # HO

H_2O in Bottle 155.8738 g

9:45 AM Safety Blade 22.04" Bottle Zero 78.90"

Source in - Init. Response IC-1, IC-2, IC-3

	liq level	ΔA	Bottle temp	
9:49	99.155	17.14	42.70	
10:11	16.300	17.14	42.70	.9973
10:17	17.252	0.06	42.70	
10:28	19.304	0.06	42.70	
10:37	19.558	8.50	42.70	
	Source out — Approx Critical			
10:43	19.543	8.41	42.70	
10:47	19.541	8.33	42.70	
10:53		8.26	42.70	
11:02	19.540	8.18	42.70	.9976
11:07	19.537	8.11	42.70	
11:12	19.537	8.02	42.70	
11:18	19.537	7.96	42.70	
11:25	19.537	7.88	42.70	
11:32	19.536	7.80	"	
35	19.534	7.69	"	
48	"	"	"	.9973

Drain Bottle.

	19.537	7.69	14.60	→ Pos Period B
12:05	Return Bottle		~~42.73~~	→ Level C
12:16	19.536	7.63	42.73	Checked calib of Beckley N
19	Safety Blade lowered to lower Power Neg Period D			
30	↓9.95"			

Safety Blade removed to level and tad adder will be adjusted to just crit.

7.55

level for 13' a)

~~level E~~

	Liq level	ΔA	Bottle	Temp		
32	19.538	7.55 ↓ 7.45	42.73		super critical	
					Approx level	E
12:52	19.534	7.45	14.61	.99713	Pos Period	F
1:09	19.530	7.45	42.76		Slightly sub critical	G
19	19.496	5.44	42.76		Neg Period	H
42	19.497	5.44	14.60		Pos "	I
2:03	19.497	5.44	42.88		Neg "	J

2:13 SCRAM → Power line surge

5-23-58 4⁰⁰ PM

Added some H_2O (UO_2F_2 contaminated rinsings)

Level before 21 3/16

after 21 15/16

1/16 in change on 1.72 liters added.

Probably too much H_2O!

5-26-58

Exp # H1 BOTTLE ZERO WITH "DILUTED SOUP"

Bottle "zero" 73.89 (Crit Ht. Should be ~19.8)

	LIQ LEVEL	TAD ADDER	BOTTLE	TEMP	SAFETY	
	99.156					
9 50 AM	Source in	17.14	42.72		22.00	
10 00 AM	~8.7					
10 07	~15.5	jogged source out and in for int response				
		Sfrom Mult.				
10 12	18.870	Beck log N = .016	ORNL log N < 0.0001	.9971		
10 24	20.358	Source out w Lead 9.06	42.72		22.00	
10 25	Raise Tad Adder to increase power level from .07 to .2					
26	20.911	11.12	42.72		22.00	
34	Lower Tad Adder to level					
35	.363	8.96				
40	.354	8.80				
45	20.348	8.96				
50	20.353	8.46	42.72	.99685	22.00	
11:05	20.358	8.34				
15	.357	8.25				
25	.357	8.25	42.72	.99683		a)
	Level for past ten Minutes					
25	Stable	Bottle In.	Back @ 0.26			
	20.358	8.25	14.71			PosPer. b)
44	20.358	8.25	42.73			level C
11:58	20.368	8.25	42.73			
	Safety Blade lowered to 9.96"			.99653		Neg Period D
12:08	Safety Blade Raised to 22.03"					level E
14	20.361	8.12	42.73			
26	20.359	8.05	42.73			} use this neg
37	20.360	7.96	42.73			} period for → E)
50	20.362	7.96	42.73			

	Liq Level	Tad Adder	Bottle	TEMP		
51	Insert bottle.					
	lost bottle, cable off pulley					Pos. Period F)
	Insert Safety, Source Beckman Log N .0075					
1 02	Replace cable on pulley - start up by removing safety					
1 12	Source out on pos. period with Bottle					
1 13	Remove bottle					
1 20	20.366	7.94	42.730	0.99650		} approx level F)
130	20.366	7.94	42.70			
1 30	Insert Bottle.					
1 35	20.366	7.94	14.72			Pos. Period G)
1 44	Remove Bottle.					
153	20.369	7.94	42.75			Approx level H)
302	lower Tad Adder					
	20.324	5.51	42.75			Neg Period I)
2 23	Insert Bottle					
	20.324	5.51	14.71			Pos Period J)
349	Remove Bottle.					
	20.325	5.51	42.74	.99622		Neg Period K)
305	Insert Bottle					
	20.324	5.51	14.72			Pos Per. L)
3 29	Remove Bottle					
	20.323	5.51	42.68			Neg Per) M
346	Dump solution.					

June 9, 1958

N.B. Galvanometer replaced with Brown-Hathaway mill mull detector ~~B~~ before ~~o~~ on June 2, 1958

DWM

6-2-58

Exp # 42 Pu Soln in Bottle R.B. CC.
weight 149.9461 g H_2O + Bottle
Add 3.0 ml Pu
Add 3.0 ml conc. Nitric

10:55 AM Safety Blade 20.00" Bottle zero 74.03"

	liq level	+A	Bottle temp	
	99.155	17.15	42.71	
11:02	Source in - Inst Response			IC-1, IC-2, IC-3
11:25	18.182	17.15	42.71	.99615
11:28	18.208	0.06	42.71	
11:48	Source	out	slightly	Pos
	20.355	6.84	42.71	.996576
12:34	20.330	5.98	42.71	.99454
12:40	20.331	5.93	42.71	
12:54	20.330	5.85	42.71	
12:59	20.330	5.81	42.71	
1:02	20.329	5.73	42.71	
	Safety	Blade	Raised to	22.03"
1:16	20.329	5.73	42.71	Approx .99642 level A
1:22	20.329	5.73	14.71	Pos Period B
1:34	20.329	5.73	42.73	level C
1:45	20.291	3.10	42.73	Neg " D
2:08	20.291	3.10	14.69	.9963 Pos " E
2:28	20.291	3.10	42.70	Neg " F
2.44	20.291	3.10	14.69	Pos " G
3:00	20.291	3.10	42.75	Neg " H
3:15	20.291	3.10	14.69	.99622 Pos " I
3:30	20.291	3.10	42.24	Neg " J

(3:44 PM) Shut Down Exp # 42

6-3-58

Exp # 43 lioH in Bottle
weight 125.8772 g H_2O + Bottle
Add 30.0 ml lioH Soln # 1

12:11 PM Safety Blade 2206
Source in - Inst Response IC-1, IC-2, IC-3

	liq level	+A	Bottle temp	
12:16	99.155	17.14	42.82	
12:38	18.071	17.14	42.82	
12:41	18.750	0.06	42.82	
12:50	20.193	0.06	42.82	
12:55	Source	out	Slightly	Pos
	20.363	7.76	42.82	
1:00	20.345	7.60	42.82	
1:03	20.342	7.48	42.82	
1:04	20.336	7.38	42.82	
1:09	20.336	7.21	42.82	
1:12	20.335	7.07	42.82	.99667
1:16	20.332	6.94	42.82	
1:22	20.326	6.87	42.82	
1:26		6.73	42.82	
1:31	20.329	6.61	42.82	
1:40	20.328	6.61	14.72	Neg
1:45	20.501	15.33	14.72	
1:48	20.517	15.78	14.72	
1:58	20.388	9.64	14.72	
2:02	20.388	9.64	42.74	.99645 Pos Period A
2:27	20.387	9.64	14.73	Neg " B

(cont'd)

Exp # 43

	lig. level	+A	Bottle	temp		
2:44 PM	20.388	9.64	42.75		Pos Period	C
3:00	20.389	9.64	14.67	.99626	Neg "	D
3:15	20.388	9.64	42.76		Pos "	E
3:30	20.391	9.64	14.68		Neg "	F
3:45	20.391	9.64	42.75		Pos "	G
4:00	20:391	9.64	14.70	.99615	Neg "	H
4:10	Shut Down Exp # 43					

Exp # 44 LIOH in Bottle R.G. cc.
Weight 145.8778g H_2O + Bottle
Add 10.0 Ml LIOH Soln # 1
Safety Blade 22.02"

10:05 AM	Source in - Inst Response IC-1, IC-2, IC-3					
	lig level	+A	Bottle	temp		
	99.159	17.15	42.73			
10:30	18.218	17.15	42.73			
10:34	18.787	0.06	42.73			
10:41	20.174	0.06	42.73	.99684		
10:45	Source out		Slightly	Pos		
	20.373	9.46	42.73			
10:47	20.353	9.21	42.73			
10:55	20.343	8.71	42.73	Slightly Pos		
10:59	20.343	8.71	14.67			
11:15	20.364	9.45	14.67	level		A
11:20	20.364	9.45	42.73	.9966	Pos Period	B
11:35	20.362	9.45	14.72	Approx level		C
11:49	20.362	9.45	42.76		Pos Period	D
12:05	20.363	9.45	14.72	.99638	Slightly Pos	E
12:17	"	"	"	Reduce Power level with blade		
12:28	"	"	"	blade out 22.06"		
1:15				.99623		
1:21	20.353	9.11	14.67	Approx level		F
1:23	20.353	9.11	42.72		Pos "	G
1:39	20.350	9.11	14.67	Approx level		H
1:57	20.353	9.11	42.75	.99612	Pos "	I

(Cont'd)

6-4-58

Exp # 44

	lig level	+A	Bottle temp			
2:16 PM	20.357	9.11	14.70		Approx. level	J
2:30	20.357	9.11	14.70	Safety blade lowered to 8.95" to Reduce Power		
2:42	Safety Blade Raiset to 22.06 ~~level~~					
2:54	20.357	9.11	14.70		Approx level	K
3:02	20.357	9.11	42.76		Pos Period	L
3:25	20.357	9.11	14.66		Approx level	M
3:44	20.357	9.11	42.74	.9960	Pos Period	N
3:56	20.357	9.11	14.68	.9960	Approx level	O
4:07	Shut Down Exp # 44					

Exp # 45 LIOH in Bottle R.B.C.C.
Weight 150.8783 g H_2O + Bottle
Add 5.0 Ml LIOH Soln # 1

Safety Blade 22.00"

	lig level	+A	Bottle temp			
9:41 AM	99.157	17.15	42.74			
10:09	Source in - Inst Response IC-1, IC-2, IC-3					
10:32	18.323	17.15	42.74			
10:35	18.801	0.06	42.74			
10:44	20.129	0.06	42.74			
10:51	Source out Slightly Neg					
	20.332	9.87	42.74	.99694		
11:39	20.318	9.48	42.74			
12:07	20.317	9.26	42.74	.99640	Approx level	A
12:13	20.317	9.26	14.70		Pos Period	B
12:30	20.320	9.26	42.72		Approx level	C
12:42	20.320	9.26	14.68		Pos Period	D
1:00	20.320	9.26	42.76		Approx level	E
1:14	20.320	9.26	14.69		Pos Period	F
1:30	20.320	9.26	42.75		Approx level	G
1:48	Safety Blade lowered 9.90" to Reduce Power level					
1:58	"	"	Raised 22.06	.99625	Approx level	
1:59	20.320	9.18	42.75		A	
2:34	20.325	9.15	42.75		Approx level	H
2:38	20.325	9.15	14.68		Pos Period	I
2:45	20.323	9.15	42.74		Approx level	J
3:09	20.322	9.15	14.66	.99615	Pos Period	K

Cont'd

Exp # 45

	lig level	tA	Bottle	temp	
3:30	20.321	9.15	42.76		Approx level L
3:39	20.321	9.15	14.69		Pos Period M
4:00	20.321	9.15	42.75		Approx level N
4:11	Shut Down Exp # 45				

6-6-58 R.B. C.C.

Exp # 46 Indium-Nitrate in Bottle

Weight 130.8817g H_2O + Bottle

Add 25.0 ML Indium Nitrate

Safety Blade 22.09"

	lig level	tA	Bottle	temp		
	99.159	17.14	42.72			
10:04 AM	Source in - Inst Response IC-1, IC-2, IC-3					
10:26	18.017	17.14	42.72			
10:30	18.954	0.06	42.72			
10:36	20.161	0.06	42.72			
10:41	Source out		Approx level			
	20.333	8.22	42.72	.99712		
11:43	20.299	7.00	42.72	.99657		
12:24	20.303	6.85	42.72		Approx level	A
12:26	20.303	6.85	14.71		Neg	
12:32	20.338	8.82	42.72		Pos Period	B
12:55	20.341	8.82	14.70		Neg "	C
1:12	20.342	8.82	42.73		Pos "	D
1:30	20.341	8.82	14.72		Neg "	E

Cont'd

Exp # 46

	lig level	tA	Bottle	temp		
1:46	20.343	8.82	42.75		Pos Period	F
2:01	20.343	8.82	14.69	.99625	Neg "	G
2:16	Shut Down Exp # 46					

6-9-58 ~~$IN(NO_3)_3$~~ $IN(NO_3)_3$ D.W.M.

Exp # 47 ~~$IN(NO_3)_3$~~ $IN(NO_3)_3$ in Bottle R.G. C.C.

Weight 145.878g H_2O + Bottle

Add 10.0 ML ~~$IN(NO_3)_3$~~ $IN(NO_3)_3$

Safety Blade 22.06 Bottle Zero 73.97"

11:05 AM	Source in - Inst Response IC-1, IC-2, IC-3					
	lig level	tA	Bottle	temp		
	99.157	17.14	42.72			
11:36	18.753	0.06	42.72			
12:01	Source out				slightly Neg	
	20.303	6.82	42.72			
12:19	20.294	7.27	14.73			
12:59	20.298	7.19	14.73			
1:05	Inserted Source to Raise power level					
1:09	Source out					
	20:302	7.19	14.73			
1:24	20.298	7.02	14.73	.99636	Approx level	A
1:34	20.302	7.02	42.71	~~.99615~~	Pos Period	B
1:59	20.302	7.02	14.70	.99628	Approx level	C
2:18	20.305	7.02	42.73		Pos Period	D
2:37	20.305	7.02	14.70		Approx level	E

(Cont'd)

6-9-58

Exp # 47

	liq level	+A	Bottle	temp		
2:57	20.298	6.71	14.70			
2:59	20.296	6.56	14.70			Neg Period F
3:18	20.298	6.56	H2.75	.9962		Pos .. G
3:44	20.295	6.56	14.72			Neg Period H
4:10	Shut Down Exp # 47					

6-10-58

Exp # 48 $In(NO_3)_3$ in Bottle R.G. C.C.
Weight 150.8774 g H_2O + Bottle
Add 5.0 ML $In(NO_3)_3$
Safety Blade 22.01"

	Source in – Inst. Response		IC-1, IC-2, IC-3		
9:43 AM	liq level	+A	Bottle	temp	
	99.158	17.14	42.71		
10:09	18.772	0.06	42.71		
10:18	20.166	0.06	42.71		
10:21	Source out		Approx level		
	20.318	7.24	42.71	.9971S	
10:33	20.293	6.71	42.71		
11:17	20.282	5.94	42.71		
11:57	20.287	5.77	42.71	.9965Z	Approx level A
12:27	20.276	5.74	14.71		Pos Period B
12:45	20.277	5.74	42.71		Approx level C
1:00	20.276	5.74	14.69		Pos Period D
1:16	20.276	5.74	42.75		Approx level E

cont'd →

6-10-58

Exp # 48

	liq level	+A	Bottle	temp	
1:33	20.275	5.74	14.69		Pos Period F
1:46	20.275	5.74	42.74		Approx level G
2:02	lowered Safety Blade at 9.0" to Decrease Power level				
2:19	Safety Blade Raised to 22.06" .99615				
2:25	20.276	5.74	42.74		Approx level H
2:35	20.276	5.64	42.74		Approx level H
2:38	20.276	5.64	14.70		Pos Period I
2:50	20.276	5.64	42.73		Approx level J
3:05	20.276	5.64	14.71		Pos Period K
3:20	20.276	5.64	42.71		Approx level L
3:36	20.276	5.64	14.69		Pos Period M
3:50	20.292	5.64	42.74		Approx level N
4:02	Shut Down Exp # 48				

6-14-58 15 ML $In(NO_3)_3$

Exp # 49 $IN(NO_3)3$ in Bottle D.W.M. C.C.

Weight 145.879 g H_2O + Bottle

Add 15.0 Ml $IN(NO_3)3$

Safety Blade 22.0" Bottle Zero 73.98"

	lig level	+A	Bottle	temp		
	99.157	17.14	14.71			
11:30	Source IN - Inst. Response IC-1, IC-2, IC-3					
12:02	18.992	0.06	14.71			
12:20	Source Out					
12:21	20.335	8.60 ↓	14.71		Super air	
12:22	20.313	8.19	14.71	.99690		
12:34	20.308	7.96				
40	20.307	7.80				
		7.72				
1 00	20.314	7.60				
07	20.311	7.51	14.71	.99657	Level	(A)
118	Remove Bottle					
	20.311	7.51	42.73		Pos Per	(B)
130	Insert Bottle					
	20.311	7.51	14.70		not Level	C)
145	Insert Blade to lower power. 10.00					
	20.327 · Blade at 10.00"				Neg Period	d)
151	Remove Blade & lower T.A. to Level					
156	20.313	7.25 ↓				
206	20.315	7.25	14.70	.99630	Sub Crit.	E
207	Remove Bottle.					
12	20.314	7.25	42.58		Pos Per	F
220	Insert Bottle					
27	20.315	7.25	14.71		Level	g)

	Lig Level	TA	Bottle	Temp		
	Lower Tad Addn 4.5"					
234	20,272	5.77	14.71	.99619	Neg Period	H
250	Remove Bottle					
	20.276	5.77	42.75		Pos Period	I
309	20.286	5.77	42.75			
309	Insert Bottle				Neg "	J
	20.284	5.77	14.69			
327	Remove Bottle					
30	20.291	5.77	42.69		Pos Per	K
	Insert Bottle					
348	20.292	5.77	14.70		Neg Per	L
400	20.296	5.77	14.70	.99600	"	L
403	Remove Bottle					
408	20.295	5.77	42.71		Pos Per	M
	Shut Down by Dumping Solution					
431	99.160					

EXP #50 June 13, 1958
15 ML LiOH

LIOH IN Bottle DWM. C.C.
Weight 145.8783 g H_2O + Bottle
Add 15.0 ML LIOH soln #1
Safety Blade 22.01 Bottle Zero
9:22 AM Source IN - Inst Response IC-1, IC-2, IC-3

	liq level	+A	Bottle temp		
	99.149	17.16	42.73		
9:47	18.796	0.06	42.73		
10:00	Source out			Pos	
	20.271	2.18	42.73	.99628	
10 46	20.253	1.64	42.73	.9960₀	
11:01	20.256	1.64	42.73	Approx level	A
11:03	20.302	3.94	42.73	→ Pos Per	B
11:06	20.293	3.55	42.73		
11:20	20.291	3.55	14.69	Neg Per	C
11:45	20.292	3.55	42.72	Pos "	D
11:58	20.291	3.55	14.71	Neg "	E
12:31	20.290	3.55	42.70	.99565 Pos "	F
12:47	20.291	3.55	14.71	Neg "	G
1:15	20.290	3.55	42.73	Pos "	H
1:29	20.292	3.55	14.70	Neg "	I
1:56	20.293	3.55	42.77	Pos "	J
2:00	20.293	3.55	14.69	Neg "	K
2:30	Shut Down Exp #50 By Dumping fuel				

EXP #51 June 16, 1958 DWM, R.B. C.C.
0.2438 g H_3BO_3 in Bottle #24 (155.897 g)
Bottle Zero 73.98 Safety Blade @ 22.01

	liq level	+A	Bottle temp		
	99.149	17.15	42.76		
10:10 AM	Source IN - Inst Response			IC-1, IC-2, IC-3	
10:28	18.037	17.15	42.76		
10:31	18.833	0.06	42.76		
10:42	Source out — slightly			Pos	
	20.281	0.71	42.76		
10:55	20.243	0.45	42.76		
11:19	20.238	0.07	42.76		
11:23	20.238	0.07	14.72	.99555	
12:29	20.270	1.57	14.73	level	A
12:31	20.270	1.57	42.70	Pos Period	B
12:47	20.270	1.57	14.72	level	C
12:02	20.270	1.57	42.72	Pos Per	D
1:15	20.270	1.57	14.71 (10.01")	level	E
1:26	lower safety Blade to Decrease Power. .99538				
1:44	Safety Blade Raised to 22.06"			level	F
2:00	20.270	1.57	42.72	Pos Per	G
2:16	20.272	1.57	14.70	.9952 level	H
2:35	20.272	1.57	42.73	Pos Per	I
2:40	20.272	1.57	14.69	.9953 level	J
3:07	Shut Down Exp #51 By Dumping fuel				

6-18-58

Exp # 52 U/235 Soln in Bottle
Weight 135.878 H_2O + Bottle
Add 20.0 Ml U/235 Soln
Safety Blade 22.03" Bottle Zero 73.97
Source in - Inst Response - IC-1, IC-2, IC-3

	liq level	+A	Bottle temp		
9:10 AM	99.147	17.15	42.72		
9:32	19.094	17.15	42.72	.99618	
9:38	20.080	0.06	42.72		
1:57	Source out		Approx level		
10:09	20.231	7.21	42.72	.99609	
11:10	~~20.220~~	6.65	42.72	.99584	
11:12	20.108	0.63	42.72	log N Cal. O.K	
11:15	20.108	0.63	14.68	Pos Period	A
11:29	20.108	0.63	42.71	Neg "	B
11:40	20.108	0.63	14.69	Pos Period	C
11:53	20.108	0.63	42.73	Neg "	D
12:04	20.108	0.63	14.67	Pos "	E
12:17	20.108	0.63	42.75	Neg "	F
12:30	20.108	0.63	14.67	.99568 Pos "	G
12:44	20.108	0.63	42.76	Neg "	H
12:58	Shut Down Exp # 52 By Dumping fuel				

6-24-58

Exp # 53 Re-Run of Exp # 52

R.G. D.W.M. cc

Safety Blade 22.0" Bottle Zero 74.06
Source in - Inst - Response IC-1, IC-2, IC-3

	liq level	+A	Bottle temp		
12:04 PM	99.100	17.14	42.75		
12:31	16.094	17.14	42.75		
12:38	19.062	5.93	42.75		
12:56	Source out		slightly Pos		
	20.255	7.17	42.75	.99743	
2:02	20.205	6.18	42.75	Approx level	
2:04	20.190	0.64	42.75		
2:07	20.186	0.14	14.73	.99698 Pos Per	A
2:21	20.181	0.14	42.76	Neg "	B
2:33	Liquid Level Defective	0.14	14.70	Pos "	C
2:45		0.14	42.74	Neg "	D
2:58		0.14	14.72	Pos "	E
3:11		0.14	42.7	Neg "	F
3:22		0.14	14.69	.99665 Pos "	G
3:35		0.14	42.76	.99656 Neg "	H
3:50	Shut Down Exp # 53 By Dumping Soln				

#53 Sample Wts Gross 156.353 g.
Tare 20.322 g
Sample Solution Wt 136.031 g

Exp. #54 Pu Sample 0.211 g

$Pu(SO_4)_2$ 0.434 g 0.0565g

HNO_3 3.5ML 70% HNO_3 4.970 g

H_2O ~132.5ML

Gross WT 159.714

Bottle (tare) 20.322

Solution 139.392 g

239 98.31 at %
240 1.66 "
241 .03 "

Reg No. 22.54
(Harman) 5-7-58

Liq. Level Tad Adder Bottle Temp

~ 9:30 June 26

Inst. Checked.

Safety Blade 22.06" Bottle Zero 74.04

99.149 17.14 42.70

12:23 PM Source IN - Inst Response IC-1, IC-2, IC-3

Bottle knocked off string by source
Fished out and rezeroed at 73.99
4:00pm also filled bottle holder with water.

June 27th

Rechecked Instruments, Rezeroed bottle at 74.05

Source IN - Inst Response IC-1, IC-2, IC-3

10:06	liq level	+A	Bottle	temp
	99.148	17.15	42.73	
10:22	11.066	17.15	14.70	
10:34	18.904	2.92	14.70	
10:45	Source	out	Pos	
	19.571	0.07	14.70	
10:50	19.580	0.58	14.70	
11:00	19.570	0.40 (0.22)	14.70	.99654
11:15	Dump some solution then feed valve and raise tad adder			
17	19.572	0.60	14.70	
18	19.573	0.78		

Cont. Next Page

Exp # 54 6-27-58

	Liq Level	TAD Adder	Bottle Temp			
11[20]	19.575	0.90	14.70	.99645		
12:49	19.570	0.72	14.70	Approx level		
12:55	19.676	6.74	14.70		Pos Per	A
1:01	19.679	6.74	42.70		Neg "	B
1:18	19.684	6.74	14.71		Pos "	C
1:25	19.661	6.02	14.71			
	Beckman log N was found to be off Calb. and					
	was ~~Re-Cab~~ Re-Calibrated					
	Do Not use A, B, And C Periods					
1:31	19.675 19.668	6.02	42.75		Neg Per	D
1:56	19.675	6.02	14.70		Pos Per	E
2:02	19.674	6.02	42.72	.99595	Neg Per	F
2[19]	19.676	6.02	14.72		Pos	G
2[30]	19.659	6.02	42.76		Neg	H
2[44]	19.659	6.02	14.72		Pos.	I
3[00]	19.659	6.02	42.70		Neg	J
~~3[15]~~	19.629	6.02	14.71		Pos	K
3:28	19.629	6.02	42.74		Neg	L
3:37	19.627	6.02	14.72		Pos	M
3:49	19.630	6.02	42.75	.99567	Neg	N
4:02	lowered Safety Blade 0.24"					
	Checked liq level Device					
	N.B. The float was [redacted] not in line					
	with photo cell, but would be in error.					
	Adjusted the balance point pot. so that					
	the top of float corresponded to mid point					
	of photo cell.					

6-30-58

Exp # 55 Re-Run of Exp # 54

Safety Blade 22.04 Bottle Zero 74.03

liq level	TA	Bottle temp
99.149	17.14	14.70

10:12	Source in - Inst Response IC-1, IC-2, IC-3					
10:43	liq level Devise out of order					
	—	17.14	14.70			
10:53	—	0.07	14.70			
11:02	Source out slightly Pos					
	—	0.07 0.31	14.70 14.70	.99595		
12:23	—	6.32	14.70	.99553	Pos Per	A
12:31	—	6.32	42.73		Neg "	B
12:46	—	6.32	14.71		Pos "	C
12:57	—	6.32	42.72		Neg "	D
1:13	—	6.32	14.69		Pos "	E
1:24	—	6.32	42.73	.99545	Neg "	F
~~1:41~~	—	6.32	14.69		Pos "	G
1:52	-	6.32	42.73		Neg "	H
2:07	—	6.32	14.70		Pos "	I
2:18	—	6.32	42.72		Neg "	J
2:36	-	6.32	14.69		Pos "	K
2:47	—	6.32	42.72		Neg "	L
3:03	—	6.32	14.69		Pos "	M
3:15	—	6.32	42.74	.9952	Neg "	N
3:35	Shut Down Exp # 55 By Dumping fuel					

7-1-58

Exp # 56 Re-Run of Exp # 54, 55 — Pu Sample

Bottle zero 73.97

Safety Blade 22.04"

	lig level	+A	Bottle	temp	
	out of order	17.14	14.68		
9:26 AM	Source IN - Inst Response		IC-1, IC-2		
9:50	18.428	17.14	14.68		
9:54	18.845	1.95	14.68		
10:—	19.982	1.95	14.68		
	Source out		Pos		
10:09	19.936	1.40	14.68		
10:47	20.048	6.68	14.68	.9968	Raise Power level
10:53	19.954	0.86	14.68		Approx level
11:12	19.920	0.45	14.68		
11:13	20.050	6.45	14.68		Raise Pr level
11:16	19.940	0.48	14.68		Approx level
11:29	19.920	0.40	14.68		level
11:30	20.019	5.39	42.70		Neg Per A
11:44	20.013	5.39	14.71		Pos " B
11:58	20.016	5.39	42.73		Neg " C
12:18	20.012	5.39	14.68		Pos " D
12:25	20.014	5.39	42.73		Neg " E
12:39	20.007	5.39	14.67		Pos " F
12:52	19.999	5.39	42.74		Neg " G
1:06	19.999	5.39	14.67		Pos " H
1:22	19.999	5.39	42.75		Neg " I
1:36	19.999	5.39	14.67		Pos " J
	20.010	5.39	42.59	.9958	Neg K

2:06	20.010	5.39	14.71		Pos Per L
2:15	Shut Down Exp # 56 By Dumping Soln				

7-2-58

Exp # 57 U/233 Sample in Bottle

Weight 140.8749 g H_2O + Bottle

Add 15.0 ML U/233

Safety Blade 22.05" Bottle Zero 73.98"

10:37	Source IN - Inst Response		IC-1, IC-2, IC-3		
	lig level	+A	Bottle	temp	
	99.157	17.14	14.69		
	99.148	17.14	14.67	.9966	
11:20	19.107	17.14	14.67		
11:22	18.936	0.07	14.67		
11:33	Source out —		Slightly	Pos	
	19.886	0.07	14.67	.99676	
12:46	19.863	0.12	14.67	.9962	
1:27	19.856	1.11	14.67		Approx level
1:43	19.950	6.0	14.67		Pos Per A
1:55	19.941	6.0	42.70		Neg " B
2:05	19.940	6.0	14.70	.9960	Pos " C
2:20 PM	19.941	6.00	42.69		Neg " D
2:30	19.943	6.00	14.69		Pos " E
2:44	19.947	6.00	42.74		Neg " F
2:55	19.944	6.00	14.69		Pos " G
3:09	19.943	6.00	42.73	.99573	Neg " H

Cont —

Exp # 57 7-2-58

	liq level	+A	Bottle	temp	
3:19	19.942	6.0	14.68		Pos Per I
3:34	19.944	6.0	42.74		Neg " J
3:45	Shut Down Exp # 57 By Dumping Soln				

Liq. Level Maintenance.

Painted float with red glyptal so that it is opaque to light.
Reinstalled in liquid level manometer with a 2 1/4" pc of polyethylene tubing stuck on a stop. Re zeroed Nr. solution in reactor
When solution is dumped liq level read 99.384
later 99.380

N.B Bottle wt of # 57 and 58

15ML X 1.052	= 15.78
H_2O + Bottle	140.88
	156.66
less bottle	20.32
Total solution wt	136.34 g

July 3, 1958 Exp. # 58
Repeat of # 57. (15ML $U^{233}O_2(NO_3)_2$
Liq level = 99.379 Safety = 22.00
Bottle zero is 74.02 Safety Blade 22.01"

	liq level	+A	Bottle	temp	
9:45 AM	99.375	17.14	14.70		
9:50 AM	Source IN - Inst Response IC-1, IC-2, IC-3				
10:11	19.045	17.14	14.70		
10:14	18.936	4.83	14.70	(source out)	
10:30	20.101	9.03	14.70	Slightly Pos	
10:47	20.067	8.21	14.70	.99628	
12:17	20.067	7.42	14.70	.99588	Approx level
12:18	19.686	12.44	14.70		Pos Per A
12:28	19.670	12.44	42.71		Neg " B
12:38	19.677	12.44	———		Pos " C
12:50	19.672	12.44	14.72		
1:00	Beckman (log N) was off Cal During Per A and B				
1:11	19.672	12.44	42.71		Neg " D
1:25	19.671	12.44	14.69		Pos " E
1:35	19.645	12.44	42.72		Neg " F
1:48	out of order	12.44	14.68		Pos " G
1:59	—	12.44	42.72		Neg " H
2:12	—	12.44	14.69		Pos " I
2:23	—	12.44	42.70		Neg " J
2:37	—	12.44	14.68		Pos " K
2:47	—	12.44	42.73	.9954	Neg " L
	—	12.44	14.69		Pos " M

Cont →

7-3-58

Exp # 58

	lig level	+A	Bottle temp	
3:00	out of order	12.44	42.72	Neg Per N
3:14	Shut Down Exp #58 By Draining Soln			

July 7, 1958 Exp # 59

gross Bottle wt 155.886 g

Bottle zero with H_2O only

Position zero @ 73.97

Lig Level 99.295

	Lig Level	Rad Adder	Bottle Temp		
11[25]	Start Solution in. To check Float in Lig level				
	Float stuck - opened tube and freed float				
11[41]	6.5	17.14	42.73	Safety @ 22.00	
12[00]	approx Crit. Source out, Raise Powered				
~~12[08]~~	~~Bad 21.01~~				
12[08]	20.215	7.01	42.73	Log N .26	
12[10]		6.49			
12[12]	20.192	6.26			
12[13]		6.02			
12[28]	20.183	5.70			
12[40]	20.186	5.49		.99576	
1[02]	20.185	5.37			
1[10]	20.186	5.31			
1[13]		5.21			
1[33]		5.26			
1[53]	20.183	5.26		Approx Level	A)
1[58]	20.182	5.26	14.71	Pos Period	B)
2[10]	20.183	5.26	42.69	Approx Level	C)
2[22]		5.17		Level	D)
2[26]		~~5.17~~ ~~12.87~~	Blade To 10.01	Neg Period	E)
2[40]		5.17	" " 22.01	~~Level~~	~~F)~~
2[48]	20.181	5.08	42.69	Level	F

	Lig Lev	Tad Adder	Bottle	Temp	
3 02 PM	20.180	5.08	14.70	.99535	Pos Per Q
315	20.180	5.08	42.72		Level H
	↓ Change to oscillation Method				
3 24	20.179	3.33	42.72		Neg Period I
3 45	20.179	3.33	14.69		Pos Period J
3 55	20.179	3.33	42.73	.99519	Neg Period K
4 16	20.183	3.33	14.71		Pos Period L
4 30	Shut down by dumping solution				
	99.327				

Exp #60

Power Level Determination for calibrating Dys – Al alloy foils.

Dy-13 taped to side of reactor 18" up in plastic foil holder.

2 10 PM Start solution in reactor Source in Bladder at 22.02

	Lig Level	Tad Adder	Blade	Temp
2 17 PM	20.3.0 "	17.15	22.02	
2 29:20	10.0 "			
3 35	Source out rising on ~ 100 sec period			
3 37	20.229	11.15	22.02	log N = 20.5
3 39:38	Start foil exposure			log N = 3.7
3 39:10	Start lowering Tad adder			log N = 10.0
3 42		3.20		"
44		3.10		"
45	20.098	2.96		"
46	20.097	2.91		10.0
47	20.096	2.87		
49	.094	2.79		"
51	.089	2.72		"
55		2.67		
57 38	Shut down with Beam Button			IRNL = 0.1

C-2 Counting rate indicated the reactor was very level (used cascaded scalers.)

127	X16 +1
126	+11
127	+0
127	+5
127	8

Exp #61 July 9, 1958

Dy-Al Foil Calibration

13 foils mounted on wheel at midplane 10" as closed to cylindrical surface as possible.

	Lig Level	Tad Adder	Safety	log N	ORNL log N's
12 50	Start Run				
12 52	2.25	17.15	22.01	7×10^{-13} ~~1.0 $\times 10^{-7}$~~	
54	7.42				
55	10.0			9×10^{-13}	
56					
57	15.00	17.15	22.01	1.8×10^{-12}	
59	18.014	10.00		8×10^{-12}	
1 00	18.291			1×10^{-11}	
1 04	19.71	1000		8.5×10^{-11}	
107	Start Source out on approx 10 sec period Pump Off				
110	19.936			1.8×10^{-9}	1.9×10^{-9}
113	19.936			2.7×10^{-8}	2.6×10^{-8}
1 13' 35"	Start timing by pomme @			3.7×10^{-8}	3.7×10^{-8}
118	19.807	2.17		1×10^{-7}	$.95 \times 10^{-7}$
120	19.802	2.00			
23	19.796	1.92			
27	19.795	1.88		1×10^{-7}	$.95 \times 10^{-7}$
29		1.83			
33	19.795	1.83			
1 33' 35"	Shut Down by pushing scram button				

Exp #62

Inst Check Out Run Comp Chamber on Back log N. (VL)

	Lig Level	Tad Adder	Safety	ORNL Log N	BECK COMP.
3 50 PM	Source in Safety at 22.00				
3 59	6.00	17.15	22.01		
4 03	13.0				
4 05	16.0				
4 15	Power level at			1.8×10^{-12}	
	Shut off Pump to room				
	scrammed by dumping solution				
4 22	Start up again.				
24	5.4"	17.14	22.01		
27	10"				
31	15.7				
42	Pulled rods			1.0×10^{-9}	6.7×10^{-11}

Increase power to 5.5×10^{-8} on compensation chamber

N.B 7 mr thru glass Window
.2 mr thru concrete wall 6' from window

4 56 Shut down

Exp #63

Dy Foil exposure

Dy Foil locations on slotted aluminum tube

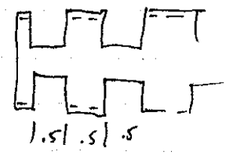
$2\frac{3}{4}$ $2\frac{1}{4}$ $1\frac{3}{4}$ $1\frac{1}{4}$ $\frac{3}{4}$ $\frac{1}{4}$" $-\frac{1}{4}$" $-1\frac{1}{4}$" $-2\frac{1}{4}$"

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

Cd Cd Cd

Covered foils.

suspended on tape from edge of tube to middle of tube.



Goal for power level ~ 0.7 $\times 10^{-8}$ ORNL

Start timing run at 1.0×10^{-8}.

N40 Source In Blade @ 21.99 Scram Reset -

	Lig level	Tab adder	Blade	log N	Beck log N
11 45	11.40	17.14	22.01	—	—
47	14.4				
12:01:20	Start Timed exposure				
12 10	20.247	5.28	22.01	2.9×10^{-8}	2.6×10^{-9}
12 13	20.240	5.13			2.75×10^{-9}
15		5.05			
18	20.233	5.05	22.01	2.9×10^{-8}	$2.7 - \times 10^{-9}$

2610 on Blackboard

2610 on window 0.8 mr/hr

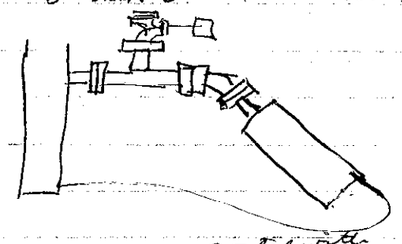
12 81 20 Shut down

Average Reading Beck lin $.99 \times 3 \times 10^{-8}$

Keithley $.56 \times 3 \times 10^{-8}$

Preparation for U-233 & U-235 Nitrate xperiment in 27" sphere

1. Added 8"Dia X 6' tank to storage



2. 27" Sphere was coated with Hercosite previous coats were chipped near bottom & inside. No attempt was made to remove old Hercosite.

3. Rinsed old system with acid and sloshed water down the sides of the 3" slab tank.

4. Acquired 232 l of distilled H_2O from Bill Vaughan, added 162 l left on slab 40 1/4 in. ~ 4.025 l/in calibr.

5. Zeroed the liq. level X meter
Bottom of sphere = 29.998
Liq. Level Zero on blacktape ~1.76.

6. Pumped ~162 l into sphere ht = 30.6 ϕ 7
10
Actual Ht 20.6.17

Repeat pumping into sphere
Lost Prime on pump @ 30.880

N.B. ESTIMATED SENSITIVITY OF ION CHAMBERS. ENRICHED 4×10^{-13} amp/mv
NORMAL 1.3×10^{-13} amp/mv
ERICHARD ROHRER

7. Temperature system changed
100 Ω standard placed in room, standardized at 1.00000 as that automatic computation for ends was achieved.
Encased 100Ω ~~Standard~~ thermohm in
plastic tubing sealed end with rubber stopper
filled with water for heat transfer.
100Ω precision replaced 100Ω standard in controlroom
Eliminated room thermohm.
Placed 0.1°C thermometer near thermohm
thermometer = 24.1°C
thermohm = 24.22°C (.9970Ω)

8. C_1 and C_2 on floor pointing at sphere
C_3 in paraffin pig, Broadside to sphere ~ 3' away.
(C_3 has counter borrowed from Lynn in East.

July 23, 1958

Exp #64

Multiplication Data for 27" $U^{235}O_2(NO_3)$

	CRITICAL Exp. C_1	C_2	C_3	Time	M_1	M_2	M_3
Bkg	10x16+2	17x16+8	21x16+14	10'			
Source	35x16+1	53 +11	(31 +8)				

Noticed that C_3 is not scaling properly

Source+H_2O							
12^{00} source	32x16+6	29x16+11	64x16+8	10'			
12^{30} source + H_2O	8 +10	9 +3	34 +13	10'			

Adjusted liq level device so that float is not needed, but use the refraction of light by the H_2O column to bend light away from photo cell. Reserved 0.000 = bottom of sphere

Added ~ 8 ℓ or 2 kg U of $UO_2(NO_3)_2$ (1.941 kg U)

.255 source + sphere + tank	32 x16+10	36 x16+11	70x16+10	10'			
3:39	Added solution		μ + 21.5-49"				

Counter #	1	2	3
	8 +9	11 +1	53 +5

Reg No 166152 Bottle of $UO_2(NO_3)_2$ (1.941 kg U) added to system

July 24, 1958 Dwm c e

The liquid level transmitter would not function properly without a float be cause the tube is not guided with respect to the photo cell and lamp bulb. the float was replaced in the tube, and a restriction made in the entrance to the manometer tube. this restriction reduces the bounce, but is not small enough to retard the flow. A momentary opening of the feed valve results in approx 0.5 in increase in level when solution is rising in the connecting pipe to sphere. Hence care must be exercised when filling to prevent overflow at top. Transmitter was zeroed

Time	Condition	C_1	C_2	C_3	Counting Time
9 00	Source Out + Sphere Empty	X16*	15 X16+0	30X16+1	10'
9 10	Source In	32 +14	37 +9	66 +3	10'
9 52	Rod In Source In +21.551	9 +13	10 +15	34+8	10'
10 12	Rod Out Source In +21.534	10 +9	10 +3	32+10	10'

EXP #65

Added 10" ~ 1/2 of the solution in the 2nd bottle of $UO_2(NO_3)_2$. This nitrate was filtered. Orig it had 3.97 kg ∴ Estimated amt is 3.0 kg U in system.
Added 2/3 x 15 = 10 l H_2O to system.

Check Counters and Inst Response (no params) with neutron source ($Pu Be M228$)

2:58 PM Added Soln to Reactor Ht 24.475 T 21.02°C

counter #	1	2	3
	12 +0	26 +11	29 +10

Estimate that 6 liters would fill the sphere

Exp #66 July 24, 1958 Dwm c e

Added 5" ~ 1/8 of solution in bottle or ~50 kg

Total estimated 23.5 kg in system.

Added solution to 23.5" sphere height = 25.105 T = 25.38 1.0015

Ctr # 1	2	3	M_1	M_2	M_3
15x16+3	16x16+1	43x16+5	1.5	1.6	1.3

Exp #67

Added 5" ~ 1/8 of solution in bottle ~ 5 kg Total est 40 kg.

Exp #67

July 25, 1958

		C_1 x16	C_2 x16	C_3 x16
Overnite Background Count	{9hr 16 hrs}	992 +3	974 +15	2702 +9

Raised liquid solution to 22.500", appreciable multiplication, so that no need to go higher

Removed source on neg period ~ 1/6 sec

Dump solution.

Exp # 68

Added 6 l H_2O est volume ~ 196 - 200 l

est U ~ 3.95 kg

Raised solution @ 22.512 some multiplication

log N 2.6×10^{-13} Keithley 3.1×10^{-13} Beck 0.3×10^{-12}

	Liq Level	Beckman	Keithley	Log N
	24.515	$.6 \times 10^{-12}$	$.7 \times 10^{-12}$	$.7 \times 10^{-12}$
	25.530	$.9 \times 10^{-12}$	$.95 \times 10^{-12}$	1×10^{-12}
	26.00	1.0	1.1	1.15
Full	28.25	1.3	1.3	1.35×10^{-12} Sub Critical
		Rod inserted		
	29.786	3.6×10^{-13}	3.6×10^{-13}	3.8×10^{-13}

Remove source

Dump solution

7-25-58 EXP #69

11:28 added 3/4" of soln. from the Poly. bottle

12:13 Start adding Solution to Sphere

	Level	Beck	Keith	Log N
12:30	14.3			
35	17.45	2×10^{-13}	2.5×10^{-13}	2.3×10^{-13}
40	20.500	6×10^{-13}	5.5×10^{-13}	5.5×10^{-13}
42	20.987	1.5×10^{-12}	1.45×10^{-13}	1.35×10^{-13}
	21.105			5×10^{-12}
48		Insert Rod to 15.01"		
50	21.109			1.4×10^{-13}
53	21.362			2.9×10^{-13}

this appears to be more reactive than exp #67

Dumped to 6.73"

EXP #70

Added 2 l H_2O to reactor sphere

Safety to 30.01"

102	8.61"			2×10^{-13}
106	11.37			2.4×10^{-13}
110	18.86			1.9×10^{-13}
115	17.00			1.8×10^{-13}
	20.50	5×10^{-13}	5×10^{-13}	4.8×10^{-13}
	21.00	9	9	1×10^{-12}
	21.384	Remove source		Climbing slightly
	21.354	approx level	5×10^{-12}	Sub Critical

Dump solution to 12.820

EXP #71

Add 2 l H_2O to reactor sphere

134	12.990			1×10^{-13}
	20.5			$3.8 - 4.0 \times 10^{-13}$
	21.0	6×10^{-13}	6×10^{-13}	6×10^{-13}
	21.528	2×10^{-12}	2×10^{-12}	2×10^{-12}
	21.673	Rising — Remove source		sub critical
	21.704	Nearly level	4.4×10^{-12}	approx level

lower safety to 22.95 above septum

Rod level	Safety	
21.762	22.95	Pos Period
21.762	18.67	Approx level
21.853	18.67	Pos. Period
21.853	17.40	Approx level

Shut down dump soln

Volume of liquid in septum 51" Slab tank = 151 l

6' × 8" @ 10 l/ft = 60 l

211 l

EXP 72 Remove ~ 8 l of solution from septum. Added 4 l H_2O to sphere. with dump valve closed

			Log N
245	17.5		
250	21.02	30.02	2.8×10^{-13}
	22.51	30.02	4.4×10^{-13}
	23.02	30.02	6×10^{-13}
	23.52	30.02	1.1×10^{-12}
	23.986		7×10^{-12} Rising

Remove Source very nearly level.

supercritical

300	23.986	19.92	approx level
	24.124	18.22	"
	24.343	16.39	"
	24.422	15.84	"
	24.626	14.96	"
	24.753	14.45	"
	24.975	13.52	"
	25.129	13.03	"
313	25.217	12.56	
	25.417	12.04	
	25.636	11.42	
	25.750	10.92	

approx length "

soln level	Rod	
25.915	10.42	approx level
26.053	10.01	
26.30	9.50	
26.570	9.50	approx 100 sec period
	8.79	approx level

Calc 120 sec period or 8.4¢

EXP # 73 DWM CC

Added 1 l H_2O to solution in sphere

	liq level	Safety Rod	log N	
3[35]	12.815	30.01		
	20.504	"	2.3×10^{-13}	
	21.5		2.6×10^{-13}	
	22.5		3.7×10^{-13}	
	23.5		7.5×10^{-13}	
	24.0	"	2.0×10^{-12}	
	24.25		1×10^{-11}	Rising Source out
	24.25	19.97	Nearly level 1×10^{-11}	
	24.72	15.97	" "	
	24.913	15.07		
	25.108	14.41		
	25.309	13.68		
4[05]	28.230	9.07 (nearly level)	7×10^{-12}	Temp 1.0033 = 25.85°C

Pump OFF Increase power to get mid of noise on log N. level at 10^{-10}

	28.189	10.08		
	28.201	9.12	sub	
		9.16	super	
4[25]	28.200	9.13	level	1.0037 = 25.95

This must be repeated to be certain of the mixing

EXP # 74 DWM CC

Repeat #73, leave safety rod in and go critical using the rod.

9[53]	Start solution in to sphere			
10[00]	liq level			log N
	9.5			
06	14.3			
14	21.6			
16	24.36	Start removing Rod		4×10^{-13}
	24.344		16.61	1×10^{-12}
	24.336		19.82	2×10^{-12}
	24.329		24.52	4×10^{-12} subcritical

~~Pump~~ Insert rod to raise liquid level.

Liquid level seems to have changed --
Sphere seems full at 26.5

9[28]	28.390	7.78 ↓	5×10^{-13}	
	28.338	9.14	$\sim 6 \times 10^{-13}$	Subcritical
	28.184	11.99	8.5×10^{-13}	
	28.007	14.91	3×10^{-12}	
	27.964	16.01	6×10^{-12}	Rising
	Remove Source.			
		16.75	+ Period to increase Power	
16[55]	27.931	16.01	2.7×10^{12}	TEMP 9955 = 23.82

Very close to critical

$\therefore \Delta$ rod = 6.87" } Some differences in rod pos. must be due to incomplete mixing
$\Delta T = +2.13°C$ }

11[00]	27.918	↓ 16.71	Pos Period	
	27.933	16.01	2.5×10^{-10}	T = 9956 = 23.83

~~Dump solution~~ ~~and repeat~~

~~the~~	↓ 15.01	Neg Period	
11[17]	Insert Rod and Dump solution		

$\frac{7.79\,¢}{.70} = 11.13$ ¢/inch $\qquad \frac{13.2\,¢}{1.00\,in} = 13.2$ ¢/in

July 25

EXP #75 (Repeat #73 #74) Dumice

	Liq Level	Rod	Temps	Tad adder	
117	91.56	00.43			
119	2.80	.43		17.14	
129	13.30	.43			
134	17.33	7.87		.07	Log N
144	28.416	7.87		.07	5×10^{-13}
147	28.206	12.02		.07	8×10^{-13}
148		13.00	99684=		1×10^{-12}
49	28.100	14.00		.07	1.6×10^{-12}
50	28.048	15.00		.07	2.0×10^{-12}
51	27.996	16.00		.07	3.5
	28.306	16.00		.99	
	28.296	16.50		.99	7.0×10^{-12}
		Remove source			
156	28.268	17.25		.99	+ Period
		16.44			nearly level (4 pos)
		16.40	99.69% = 24.19		sub
209	28.282	16.42			
215		16.44		.99	sub level
		16.71		.99	+ period (1)
		↓			
	28.265	17.17			+ period (2)
235	28.275	16.44	9969% = 24.20	.99	level

Dump solution to Midplane

#1 Period = 4/6 sec = 2.87 ¢ ΔT = 0.37 °C

Some mixing and some ΔT causing 2.87 ¢ change

#2 Period = 136.9 = 7.66 ¢

$\#1 = \frac{2.87}{.27}$ 10.63

$\#2 = \frac{7.66}{.73}$ 10.49

EXP #76 July 28

Add 0.5 l H_2O to Sphere half full of sol.

Resolution

	Liq Level	Tad adder	Rod	Temps	log N
310					
311	13.48	17.14	16.44 ↓		
	15.2	.07	.43		1×10^{-12}
321	22.50	.07	.43		1.1×10^{-12}
22	24.15				
24	27.135	.07			
	27.470	.97			
	28.811	1.95			
	28.162	2.98	.43		1.25×10^{-12}
	27.980	2.98	4.34		
	28.287	3.99	4.34		
	27.908	3.99	12.00		
	28.228	5.00	"		1.4×10^{-12}
	28,001	5.00	16.44		3×10^{-12}
		Source out			
	27.894	5.00	18.20 ↓		Pos PERIOD
	27.926	5.00	17.26 ↓		level
	27.969	5.00	16.44	.9969% = 24.20°C	Neg Period
			17.20		approx level

Rod drop Exp

28.861 ~.43

Dump solution and pump up again.

424	23.5	7.57	10.09	7×10^{-17}
26	28.16	11.18	12.47 ←	— Source out.
	28.090	12.00	18.76	Pos Period
430			19.50	.99805 = 24.49 Pos Period
			18.00 level	
	28.160		17.26	99821 = 24.54 Neg Period, DUMP

18.20 > 0.94" 8.8 ¢ 9.36 ¢/in
17.26

17.26
16.44 > 0.82" 9.0 ¢ 10.98

19.50 > ~~1.50"~~ ~~12.0 ¢~~ 12.0 ¢ 8.0
18.00

18.00
17.26 > 0.74 7.0 ¢ 9.46

(Reject ? 76)

EXP 77 Dwn C.C. July 29

	Liq Level	Tad Adder	Safety	Temp	log N
9 17	25.771	8.47	10.00		5 x 10⁻¹³
	28.361	12.04	10.00		5 x 10⁻¹³
	28.228	12.04	13.02		8 x 10⁻¹³
			14.02		9 x 10⁻¹³
	28.120		15.00	.99564	1.1 x 10⁻¹²
			16.01		1.7 x 10⁻¹²
			17.00		2.5 x 10⁻¹²
			18.01		still rising
	Remove source	~~Remove source~~		23.86°C	
	27.906		18.70	+108.7	Positive Period
9 35	27.929		17.67	=9.23	level
	27.928		18.00	+3.20	+ period
9 42	Dump solution				

Took Two samples using 100 ml Pipette directly from Slab tank.

EXP # 78 Dwn C C July 29

Fill	Liq level	Tad Adder	Rod Temp		log N
	↑ 1" on Liq level add 1 l H₂O to Sphere.				
10 30	1.366	17.14	10.00		2 x 10⁻¹³
10 55	28.311	12.91	10.00	.99677	5.5 x 10⁻¹³
	28.014	"	16.00		
	28.360	14.03	16.00		1.4 x 10⁻¹²
	28.275		18.02		2.5 x 10⁻¹²
	28.222	14.03	19.01		8.0 x 10⁻¹²
	28.188	Remove source			8.55 ¢
		14.03	19.50	.99682	+119.5 Pos Period
11:14	28.213	14.03	18.43	.99677	24.15 Level
11 20	28.279	14.07	17.26	.99674	-157.1 Neg Period
					11:34

11 55 Start Pumping solution in to sphere for mixing
56 1.83
57 4.0
12 04 11.0
12 10 15.62 Pump off Dump solution

EXP # 79 Dwn CC July 29

12 26	1.00	17.14	10.01		1.9 x 10⁻¹³
30	7.33	17.14	10.01		1.9 x 10⁻¹³
47	21.34	17.14	10.01		2.5 x 10⁻¹³
48	22.45	10.01	10.01		
51	28.252	11.03	10.01		4.2 x 10⁻¹³
52			16.01		7.5 x 10⁻¹³
			17.51		1.1 x 10⁻¹²
			19.01		1.7 x 10⁻¹²
	27.623	11.03	22.01		3 x 10⁻¹² Rising
	28.279	13.02	22.01		4.5 x 10⁻¹² Rising
		Source out			
	27.993	13.02	29.50	(Rod out) .99841=24.59	Slightly Positive
1 09	27.977	13.02	29.50	.99843 3.25¢	~3.5 x 10⁻¹¹ + Period
				+365.1 cc	
1 24	28.220	13.02	23.12	2.07 x 10⁻⁴	level
			↓	.99840	
		13.02	19.50	=24.58	
				-119.5 cc	~ -120 cc
				~18.2	period

July 29, 1958

	liq level	Tab Adder	Rod	Temp	log N	
	Insert source and remove rod to raise power					
	Remove source					
	② 27.989	13.02				
133	28.277	14.01	29.52	.99845	3.539	log N = 2.8×10⁻¹²
148		leveling			+350	+ Period
149	28.547	14.01	23.08	.99850	2.16×10⁻¹¹	level
202	28.660	14.01	21.01	.99851	-221	- neg Per
		Dump Solution			-7.114	
					T = 24.61	

EXP #80 cc Dwn

Repeat #79

206	start adding Soln					
07	6.2					
16	14.0					
17	14.4	8.54	10.01			
231	28.300	12.92	10.01	.99890		6×10⁻¹³
240	28.034	15.01 ②	29.5①	.99895		+ Rising
	Remove source				1.86×10⁻¹¹	
241	28.028	15.01	29.51	.99895	413 sec	Pos Period
250	28.025			.99895	2.81¢	Pos Period
302	28.881	15.01	23.11	.99895	24.74°C	level
	Dump solution					
	Took 4 100 ML samples from Tank					

~3:30 PM Changed temperature set point from 70 to 66 °F. for Run 113. Recorder in room changed from 74 to 69°F

July 30, 1958 Temperature controller held Run 113 at 69°F overnight without difficulty

Thermohm 0.9861 = 21.39 °C

EXP #81 cc Dwn

Temp Coeff of reactivity for 27" sphere.

	liq level	Tab Adder	Rod	~~log N~~	temp	
912						
913	3.0	17.14	10.06	1.9×10⁻¹³	.98626	= 21.42 °C
932	~20.0	17.14	10.06	2.3×10⁻¹³	.98605	
940	28.30	11.73	~11.8	4.2×10⁻¹³	.9849	
	Pump off					
42			15.04	8.0×10⁻¹³	.98483	
45	source out		20.50	3. ×10⁻¹²	.98479	Powm. Rising slightly
	~27.6		23.10	Pos Period (73.9 sec = ~12.2) to log N = 8.5×10⁻¹⁰	~~.98487~~	= 21.00
958	29.797	11.73	20.00	8.5×10⁻¹⁰	.98487	
1006	27.798	11.73	19.99	level	.98492	= 21.02
			19.50	Neg Period (-9.56.3 = -3.12 ¢)	.98496	
18	27.822					
			18.43	Neg Period (-165.7 = -10.35 ¢)	.98496	
1022	27.887					
			21.01	Pos Period (+207 = +5.40)	.98498	21.10
1033	27.755					
1046	27.79		19.98	Level	98507	

July 30th Preliminary Foil Run

1/2" gold foil 1" above center.

#8 5/16 U-235 foil 1" below center

According to Cronin's calibration, Diam on vertical is 26.8" ∴ Foils suspended 13.4+18 = 31.4" from Top on aluminum tube with 1/2" cutouts. Aluminum coated with

Run #82

	lig level	Tad Adder	Rod	log N	Temp
2:30	start solution into sphere				
35	7.8	17.14	15.98	2×10^{-13}	.98652
40	12.0	0.07	"	$1.8-2.1\times10^{-13}$	
45	15.9	.07	"	2.6×10^{-13}	
50	20.0	"	"	3.0×10^{-13}	
51	28.300	11.32	"	1.1×10^{-12}	.98530
	sphere full more rod.				
3:00 PM	98.11.4	11.32	20.0	$4.5\times10^{-12}\uparrow$	
	28.277	12.00	21.0	$1\times10^{-11}\uparrow$ (200 sec)	
	Source out				
3:05	28.226	12.00	22.0		
3:12	28.167		23.12	$1.1\times10^{-10}\uparrow$	.98525 Rising in Pos Period +91.3 = 10.589 min sec
3:10:10	Start timing EXPOSURE TIME 1.0×10^{-9}				
3:15	28.276	12.00	20.32	2.7×10^{-9}	~~.98531~~
17			20.31		
18			20.30		
22	28.276	12.00	20.29	2.7×10^{-9}	~~.98540~~
29	28.276	12.00	20.29	2.7×10^{-9}	.98516 = 21.13
3:30:10	Dump solution				

7-31-58

Exp # 83 cc DWM RG

#3 Cd Cd U-235 1" above center #2 Bare U-235 1" below ⊥

11:25 AM Source IN - Inst Response IC-1, IC-2, IC-3

	lig level	+A	Rod	log N	Temp
	91.561	17.14	15.03		
11:40	9.25	17.14	15.03	$\sim1.4\times10^{-13}$	
47	14.65	17.14	15.03	$\sim1.7\times10^{-13}$	
53	19.5	6.80		2.2×10^{-13}	
59	28.087	6.80	15.03	6.5×10^{-13}	
02	28.291	8.00	19.42	1.3×10^{-13}	.98435
		Source partly out			
04	Source out		21.06	2.0×10^{-13}	
08	28.164	9.00	29.50		Pos: Two Runs
18	28.156	9.00	29.50	2.0'	
11:12:50	Start Timing Foil Run.			$2.\times10^{-10}$	.98435
18	28.551	9.00	21.08	5.3×10^{-10}	
24	28.546	9.00	21.07	5.4×10^{-10}	.98446
28			21.06	5.4×10^{-10}	20.98°C
30	28.545	9.00	21.06	5.4×10^{-10}	.98450
11:32:50	Shut down by dumping solution				

Cd weight = 1.8467g

7-31-58

Exp # 84 cc DWM

1:17 PM Source IN - Inst Response IC-1, IC-2, IC-3

	lig level	+A	Rod		
	91.553	17.14	15.04	$\sim2.0\times10^{-13}$	.98660
2:25	2.80	17.14	15.04	$\sim2.4\times10^{-13}$	.98666
2:37	14.850	17.14	15.04		
45	19.715	17.14	15.04	2.8 / ~~2.5~~ $\times10^{-13}$	
50	28.174	8.08	15.04	8×10^{-13}	
	28.120	10.00	29.50		.98552
2:53	Source out, Positive Period				

	Level	Rad Adder	Rod	log N	Temp	
2:54	28.118	10.00	29.51	6×10^{-12}	.	
301	28.114	10.00	29.51	2×10^{-10}	.98550	
304:48		Start timing exposure				
310	28.464	10.00	21.40 ~~29.51~~ 21.39 21.38 21.37	2.7×10^{-9}	.98550	
314				$2.7^{+} \times 10^{-9}$		
318	28.464	10.00	21.37 21.375	2.7×10^{-9}	.98560	21.26°C

324:48 Dump solution

Aug

August 1, 1958

Ex 85

Experiment for J. T. Thomas to determine the delay time for 10¢ excess reactivity ~~to cause~~ with no source start up.

Control Rod withdrawal rate ~ 9"/Min.

Get Critical ~~with~~ source at low power $\sim 10^{-12}$ and then drive subcritical with rod after suitable delay remove rod to 10¢ excess and wait for the power to rise.

	liq level	tad	Rod	log N	Temp
1:26	12.0	17.14	13.57	$1.2 - 2.0 \times 10^{-13}$	.98676
1:35	18.8	.07	13.57	$2.0 - 2.4 \times 10^{-13}$	
		(C3 C.R(2) 11x16 + 7)			
139	22.5	.07	13.57	2.5×10^{-13}	
143	28.234	11.01	13.57	6.0×10^{-13}	
				Ke 6.0×10^{-13}	
				B 6.0×10^{-3}	
	Remove source			Log 2.6×10^{-13} K 2.6×10^{-13} B 1.5×10^{-3}	
	Insert source				
150	28.899	11.01	19.73	$\sim 9.0 \times 10^{-13}$	.98463
	Source out and approx critical (rising)				
			19.69		
			19.62		
			19.53		
			19.39	approx crit	
155	Insert Rod		~~7.01~~		
157			7.01		

N.B 19.39 → 21.37 ~ 10¢

	Level	Tabbidder	Rod	log N	Keith
2 04	28.567	11.01	7.01	—	~1.2 x 10⁻¹³
207	Start Rod Out (Keithley responded before rod to exit pos.				
0			19.39		
20"			21.41		
1:32.6"				5 x 10⁻¹³	
3:46.0"				2 x 10⁻¹²	
218	27.887	11.01	19.65	8.5 x 10⁻¹²	
221			19.71	8.5 x 10⁻¹²	very nearly level
221	Insert Rod .23				
230	Removed source from Room				
239	Start ~~our~~ rod out with no source in Room.				
0			19.70	Keithley	
15"			21.53	Shows increase.	
60'				.8 x 10⁻¹³	
1:30				1.2 x 10⁻¹³	
2:00				1.7 x 10⁻¹³	
30				1.9 x 10⁻¹³	
3:00				1.9 x 10⁻¹³	
4:00				4.1 x 10⁻¹³	
30				4.8 x 10⁻¹³	
5 30				2.7 x 3 x 10⁻¹³	
6:00				4.1 x 3 x 10⁻¹³	
7:00				6.8 x 3 x 10⁻¹³	
8:00				3.2 x 10⁻¹²	
9:00				5.4 x 10⁻¹²	
259 ~~28~~	27.867	11.01	19.75	6-5 x 10⁻¹¹	Sub
302½			19.80		level

Pumps solution

Aug 6, 1958

Six samples, 100 ml each, #6, #7, #8, #9, #10, #11, #12 were taken from the top of the slat tank in rapid succession 2 each for Y-12, 1 ORNL-Y-12, 1 for and 1 J. H. Cooper. Two to be held in reserve.

Measured Vertical Diam. = 26 3/4" ± 1/16

" Horiz Diam. = 27 5/8" and 27 7/8" ± 1/16"

Average Diam = 27.33

Vol $\frac{4\pi}{3} R^3 = \frac{\pi}{6} D^3$ Vol = $\frac{3.1416}{6} \times 27.33^3 \times 16.38$

= 175.08 liters

Drained out ~7 l of solution into 15 l bottle previously filled with 8 l of soln when reactor was super critical see p. 133.

4 45 PM Temperature Set Point → 64 → 70 for Rm 112.

Aug 11, 1958 - Cast a Paraffin cylinder for end of Cyg. Ion chamber 1¼ annulus of $(CH_2)_n$ in S.S. beaker. Put on chamber.

Aug 12, 1958

Placed PuBe Source M-227 against paraffin container on C.I.C. - Read ~ 3 x 10⁻¹¹ amp on Beckman. Lower C.P.

Calibration of Chambers E 4 x 10⁻¹³ a/mr

N 1.3 x 10⁻¹³ a/mr

August 12, 1958

Calculation of molecular volume for $UO_2(NO_3)_2$ as compared to H_2O for a displacement factor.

Density of $UO_2(NO_3)_2 \cdot 6H_2O$ = 2.807 (Chem Rubber Handbook)

$\therefore$ Molar Volume $= \frac{MW}{\rho} = \frac{502.18}{2.807} = 178.9$ cc/Mole

Volume of 6 Moles $H_2O = 6 \times 18.016 = 108.1$

Molar Volume $UO_2(NO_3)_2$ = 70.8 cc/Mole

Displacement factor $= \frac{70.8}{18.016} = 3.93$ $\frac{\text{molecules } H_2O}{\text{molecule } UO_2(NO_3)_2}$

If U is expressed in gm/ML, the H density factor correcting from atomic density of pure water is

$f = 1 - x \times \frac{3.93 \times 18.016}{235.16}$ $\quad x \equiv \frac{\text{gm U}}{\text{ML}}$

$f = 1 - 0.0167\,x$

$= 1 - 0.000334$ for $x = .020$ mg/ML

$= 0.999666$

$\therefore$ Displacement of H_2O by uranium is unimportant in this experiment.

Check before using 3-59

Aug 18 12^{30}

Aug 18, 1958

14 2 liter bottles arrived containing ~ 5.2 kg U-233. $\therefore$ 7 bottles were pour in slab tank containing approx. 175 l of H_2O with pump recirculating solution. Finished filling ~ 12^{00} continue circulation

Beckman $1.8 \times 10^{-13} \rightarrow 3.7 \times 10^{-13}$

Keithley $2.4 \times 10^{-13} \rightarrow 4.2 \times 10^{-13}$

This instrument increase is believed due to residual gamma activity in the U-233 solution (Air sample filter > 10000 ϕ/MIN)

Estimated inventory in slab tank is 2.6 kg

Source In readings

B	0.7×10^{-12}
IT	2.6×10^{-13}
Blg	9×10^{-13}
ORNL	1.15×10^{-12}
CIC	$\sim 1 \times 10^{-13}$

EXP 85 Dwn Rg.

~12 30 Start pumping solution in to sphere

Liq Level	Blg N	ORNL Log N	B lin	K lin	TAD	SAFETY
55 11.982	9×10^{-13}	1.2×10^{-13}	$.7 \times 10^{-12}$	8×10^{-12}	17.14	30.01

STOP To LET T.T.-LYNN remove Block out rear gate.

Temp = 99905 = 24.76

25 Start pumping solution into Sphere.

36 Stop. Adding so that Bob Parker 18.910

145	27.137	1.1×10^{-12}	1.23×10^{-12}	$.95 \times 10^{-12}$	1.1×10^{-12}	17.14	30.01

Remove source with sphere full of solution

Beck Log N	1.1	→ 1.0 x10⁻¹²
ORNL " "	1.25	→ 1.06 x10⁻¹²
B lin	1.0	.9 x10⁻¹²
K lin	1.05	→ 1.0 x10⁻¹²

Dump solution - run emergency fan after main switch turned on.

Y-12 -4C entire pie reads 260 MR on side of 2l std bottle #UP-110.
γ- Buildup

Aug 18, 2:25 PM	260 MR	
19 3:00 PM	500	
20		
21		
22		
23		

Bottles emptied UP 97, 98, 99, 100, 101, 102, 103,

Added 1 bottle ~ 370 g U-233 UP-104

Total now 2.97 kg in system.

EXP #87 DWM RG

	Liglev	Tachable	safety	B lin	K lin	B log	ORNL log.	temp
	91.556	17.14	30.01	.7x10⁻¹²	.9x10⁻¹²	9.5x10⁻¹³	1.05 x10⁻¹³	
2 21	.664				+ x10⁻¹²	1 x10⁻¹¹	1.15 x10⁻¹¹	.99
3 07	27.108	17.14	30.01	1.2 x10⁻¹²	1.3 x10⁻¹²	1.2 x10⁻¹²	1.28 x10⁻¹¹	1.00294 =25.76
3 15	Pump off 27.091				1.2 x10⁻¹²	1.15 x10⁻¹²		=25.81
	source out			1.1 x10⁻¹²	1.2 x10⁻¹²	1.0 x10⁻¹²	1.05 x10⁻¹¹	1.00315

Dump solution / EXP # 88 DWM RG

add ~ 1/2 bottle UP-105 ~3.15 kg

3 40	start solution into column					
	0.5	17.14	30.00			
3 54	stopped } change filter samples.					
4 00	started }					
4 12	sphere full					
		1.3	1.4	1.4	1.25	1.00349=25.90

	C_1	C_2	C_3	*
Source in	43x16 +4	15x16 +13	62x16 +5	
Out	6 +10	7 7	15 +15	
	.23	.625	.86	

add remainder of U-P-105 total 3.34 kg.

EXP # 89 DWM RG.

5 15 Sphere full 27.264

	1.6	1.85	1.75	1.4	1.00405=26.04
	53x16 +9	26x16 +13	65x16 +5		
	8+9	9 +3	15 +11		
	.19	.37	.15		

Aug 19, 1958

Exp # 90 Dwm WCT

Rm Temp @ 70°F, Repeat of #89

Inst Check Consisted of clunking all rest for response with neutron source, and manual trips with gamma source DWM & WCT.

Liq level	Bein	K Lin	Blog	ORNL
27.101	2.1×10^{-12}	2.2×10^{-12}	2.3×10^{-12}	1.5×10^{-11}

Temp .9851 → 21.06

C-1 =	50 x16	+14	.020
C-2 =	23 x	15	.041
C-3	81	4	.0123

Scratched

EXP #91 Dwm WCT

Added ~ ¼ of Bottle UP-106 or 90 gm U-233

Total Mass ~ 3.43 kg.

229 Started Pump circulating with open to mix the solution

306 Stop Circulation

312 Start pumping solution.

338

					Temp
27.115	2.4	2.6	2.7	1.5	.9872
C-1	63	+12	.0156		.9882 = ~~22.0~~ 21.93°C
C-2	35	+10	.0278		
C-3	101	+4	.0099		

Remove source

1.85 2.0 2.1 1.2

Aug 19, 1958

EXP #92 Dwm WCT

added ¼ of bottle UP-106 or ~90 gm

Total Mass ~ 3.52 kg ~

Circulation started open for ~ 10-15 minutes. Dwm

Liq Level	Bein	K	Blog	ORNL	Temp
27.135	4.4	4.5	4.6×10^{-12}	1.75×10^{-11}	.9897 = 22.35

C_1	130 x16	+15	.00763
C_2	101	3	.0099
C_3	248	8	.00403

Source out

2.4 2.5 2.6×10^{-12} 1.2×10^{-11}

C_1	27	+14	
C_2	29	+11	
C_3	59	+14	.9897

Above is evidence of a source of neutrons in the solution. C_1, C_2 and C_3 are approx 4 times higher in counting rate as on p 151. (without source)

EXP #93 Aug 19, DWM WCT

Repeat #92 without any addition.

27.263 4.4 4.5 4.7×10^{-12} 1.8 .9902 = 22.42

C_1	132	4
C_2	105	15
C_3	248	7

Aug 19

Exp # 94 Dwdm 2 WCT

Added ~ 1/8 of Bottle UP 106 (5/16" by measurement of total height)
assed solution

~5 yrs

6⁰⁰ Shut off Circ Pump (With Open
∴ Mixed for ~ 15 Min

Aug 20, 1958

Discovered 500 CFM Ceiling exh fan does not run.
To obtain pressure differential inlet to 113 system in corridor was covered with tape. A new fan should be ordered

	Lig level	Beck	Keith	Bldg ORNL bg	Temp
9³¹ AM	7.5	1.4	1.6	1.9×10^{-12}	1.3×10^{-11} .9860 = 21.36

Rod

10²⁵ 27.937 On stable period 28.76 CIC Temp

$.6 \times 3 \times 10^{9}$ $.56 \times 3 \times 10^{-9}$ 1.8×10^{9} 3.3×10^{-9} 10^{-9} .98473 = 21.03 °C

10³² Critical - Rod Position = 21.80 T = .98480 = 21.05 °C

Neg Period - Rod @ 21.01 (Lig level = 28.018) T = ?

Pos Period 23.08 T = ?

Level Rod @ 21.79 T = 0.98495 = 21.08

Neg Period 20.00

Pos Period 30.01 T = 0.98498 21.10

EXP # 95

Move CIC chamber back from contact with sphere so that the 233 sphere is as bare as the previous case Repeat #84 to be certain of mixing.

	Lig. Level	Rad Adder	Rod		Temp	
10⁴ PM	13.0	17.15	20.01			
10⁸ PM	16.2	10.08	20.01			
113	21.3					
121	28.105	12.41	20.01	Sub Crit.		
125	28.012	12.41	22.02	reactor @ 2.2×10^{-11} source out	.9860	21.36
142	28.142	12.98	22.71	Nearby level @ 1×10^{-9}	.98596	21.34
148	28.142	12.98	22.68		.98614	21.40 °C
150	28.142	12.98	22.68	Level	~~.99596~~	~~21.34~~ °C

Critical Position

CIC = 5×10^{-11}

Blank = 9×10^{-10}

Calculated period +117.3 sec → 3.0391×10^{-4}

k = 1.0003.04 @ 21.40 °C

Exp #96 Dwn V.H.

Repeat of experiment #95, temperature has been increased approx 2 °F by recorder in reactor room 113.

	Liq. Level	~~Rod~~ Addn	Rod	B Log N	Temp	
8[31]	91.549	17.15	30.01	1.9×10^{-12}	—	
37	4.	17.15	20.01	2.2×10^{-12}		
~~44~~	13.0					
50	17.2	9.99	20.01	3.7×10^{-12}		
59	28.079	13.82	20.01	2×10^{-11}	Source in sub-crit. → .98842	
9[10]	28.081	14.36	23.05	1.9×10^{-10}	.98824	Source out

Reactor just critical

lower power to ~ $.05\times10^{-11}$ before pos.. per to determine ~~task~~

9[15]	28.149	14.34	21.79[5]	—	98825	Neg Period
9[18]	Rod ~~to~~		30.09		a	
9[22]	27.989	1489	30.09		98830	Pos Period
9[25]	Start To level					
932	28.256	14.89	~~30.09~~ 23.06		.98838	Nearly Level
936	28.257	14.89	23.05		.98840 = 21.99	Level
			↓ 22.68			Neg Period
945			22.68 ↓ 21.79		.98845	
950	28.330	14.89	21.79		.98850 = 22.01	Neg Period

Dump solution

finis

$k_{excess} = 1.00024_{35}$

Exp #97 Dwn

Cd Covered and Bare U-235 foil in center of assembly. (Previous 235 runs at 5.4×10^{-10} amps)

2[00] Start solution into sphere.

2[17] 20.4

3[04] Sphere full 6×10^{-12} source in Rod @ 14.02

Cannot get to power.

4.5×10^{-11} Shut down

Temp .9871

Temp Recorder Control point set at 60

Aug 25 EXP #98

(113) Rm Temp 68°F on recorder

Should get crit cal this time for U-235 foil bare and Cd covered run.

	Lig Level	Ted adder Rod	Temp	Beck Log N
10 01	Start pumping solution Rod at 150			
02	Source in Beck Log N = 2.0 x 10⁻¹²			
	Beck 1.65			
	K ~~1.95~~ x 10⁻¹⁻			
	ORNL 1.4 x 10⁻¹³			
	appears to have more gamma background			
14	11.5	17.14	15.01	.9794 = 19.86°c
15	15.0	17.14	15.01	
		10.00		
16	15.85			4.2 x 10⁻¹²
	Stopped to give Metal fire extinguisher to Dilley			
23	21.50	10.00	15.01	5.4 x 10⁻¹²
27	28/20	13.99	15.01	.97775=19. 8 x 10⁻¹²
	Rising on ~150 cc prism → 2.388 x 10⁻⁴ = β			
10 35 35	Start turning			
40	28.265	15.78	23.18	.9 5.5 x 10⁻¹⁰
44	28.273	15.78	23.04	.97747
46	28.274	15.78	23.04	.97750
50	28.275	15.78	23.04	.97755
10 55 35	Shut Down Turn emergency fan on.			
1205	Turn off emerg fan, start air conditioning			

Sept 7 Lab work 160mm recharged

Sept 5, 1958

In preparation for Boron Poisoning experiments with U-233

50.7 g H_3BO_3 + 1200 cc U-233 soln of ~220 g/l + ~~400~~ cc U-233 of ~17 g/l were mixed in 2 l graduate. Nearly all the boric acid was in solution, but waiting until Monday should dissolve it all. Dwn

Sept 8, 958

Additional stirring would not put all the boric acid in solution several grams estimated not to be in solution.

EXP #99 (800cc U-233 + boron)

800 cc of the 1650 cc added to syphon.

10 AM	started circulation pump to mix.	
10 15	Start pumping thru syphon for mixing	
10 23	5.3 in	Circ still wide gap
10 31	9.4	
10 35	11.4	Stop Pump drain back thru fed valve
10 40	8.4	
43	6.35	
46	3.9	
47	2.85	
48	1.40	start Pump.
10 ~~51~~	4.6	
55	7.0	
11 0~~5~~	12.0	
08	13.7	
13	17.0	
11 35	Source Out Critical low power.	

EXP #99

	Liq Level	T.A.	Rod	
	27.989	15.63	20.99	.99022 = 22.45 Super.
11:42	27.917	15.63	22.01	Pos Period
48	27.987	15.63	21.05	Nearly level
49	27.987	15.63	21.05	.9902 = 22.45 °C
51	Dump ~~thru~~ feed valve			
12 18	91.562			
	Start Circulation with dump valve open			
12 58	End mixing			

Sept 8, 1958 EXP #100 Repeat of 99 after mixing for 40 Minutes.

12 58	91.549	Start feeding		
100	4.44	17.14	21.05	
06	11.91			.9885.
13	19.00	6.21	21.05	
24	Source out sphere full			
26	28.030	15.00	22.51	.99254 = 23.04 Pos Per.
29	27.977	15.00	23.11	.9930 = 23.18 P
36	28.085	15.00	21.42	Nearly level.
40	28.087	15.00	21.38 21.40	Sub
42	28.087	15.00	21.40	.99296 = 23.17 LEVEL

42½ Drain thru feed valve
54 13.40

Drain out ~1½ l of solution in bottle and took 6 samples #23 #24 #25 #26 #27 #28

Sept 9 EXP #101 D2O in C.E

	Liq level	T.A.	Rod	Temp.	
851	96.	17.14	19.85	.99746 = 24.31	Rm temp.
55	7.1				
902	14.5				
915	28.054	14.83	19.85	.9966	
	28.096	15.28	21.96		
21	28.094	15.28	21.61		Source out Slightly Sub
24	28.002	15.28	24.00	.99646 = ~~23.84~~ 24.08	Pos. Period
37	28.087	15.28	21.81	.9965 = 24.08	Level
	28.147	15.28	20.61	.99658 = 24.11 °C	Neg Period
	27.807	15.28	29.78		Rod Out Pos Per
10 11	28.089	15.28	21.80	.9966 = 24.11°C	Level

Shut down by draining thru feed valve.

EXP #101 δk = 60.8 sec → 4.866×10^{-4} T = 24.11°C

100 δk = 91.3 sec → 3.671 + (#96 = 155.4 sec) = 6.106×10^{-4} T =

$\left(\frac{2.435}{21.40 - 84} = 5.12 \times 10^{-4}\right)$ 23.18°C

$$\frac{\delta k}{\delta t} = \frac{1.240 \times 10^{-4}}{.93} = 1.33 \times 10^{-4}/°C$$

k = ~~1.0013~~ @ 20°C

Added remainder of Boron U-233 solution
+ about 0.8ℓ of solution drained for taking samples

11^{25} Started circulation pump to mix
Cir valve wide open.

11^{20} Closed Cir Valve, cracked open a little.

EXP # 102 (2nd Boron Loading)

	Liq Level	Tap Reading	Rod	Temp	
	91.556	17.14	21.80		
12^{25}	NO	17.15	21.80	99742 =	
35	13.9	17.15	21.80		
36	14.8	5.96			Source out
49	28.00	14.69	22.10	1.00070	Approx level
54	28.016	15.78	30.02	1.00104	Pos Per
104	28.336	15.78	22.28		
104			22.24	1.00095	
108	28.336	15.78	22.21	1.00092	= 25.24°C

Drain thru feed valve.

$\delta k = (86.9 sec) = 3.7999 \times 10^{-4}$

EXP # 103 (Repeat of 102) AWM C.C

	Liq. Level	Tap Reading	Rod	Temp	
145	9.0	17.14	22.21	.99977	
150	15.6				
153	20.0	4.92	20.41		
	Source out		approx	Crit	
201	28.002	14.30	22.17	1.00120	~~1.00120~~
208	28.002	15.37	30.02	1.00115	Pos Period
			22.25	Super	
			22.23	Sub crit	
230	28.305	15.37	22.24	1.00126	25.32 Level

Drain thru feed valve

$\delta k = (86.9 sec) = 3.7999 \times 10^{-4}$

@ 20.0°C ρ = ~~1.00128~~

9-10-58

Took 6 samples #29, 30, 31, 32, 33, & 34

Mixed in 2ℓ graduate 1000 ml 270 g/ℓ
50.73 g H_3BO_3
added solution from system to make 2ℓ

Added 1000 ml of above solution to system system contains ~75g boron

10^{15} Start Mixing — full circulation Rate

N.S source bkg now 2.75 ~~$\times 10^{-12}$~~ Beck
4.0 $\times 10^{-12}$ Beck log N

12^{23} Pump Off

EXP # 104 ~75 g H_3BO_3 + U^{233}
(Mixed for 1 hr + 35')

	Liq Level	Tad	Rod	Temp
1240	91.573	15.37	22.25	
44	3.5	17.14	20.01	
50	14.0	17.14	20.01	.9870,
55	20.2	6.34	21.01	
101	Sphere full			
105	28.422	17.14	30.01	.99326 = 23.24 °C

Sub critical

Beck log N 2.7 x 10⁻¹¹

Remove source. ~1.35 x 10⁻¹¹

Drain thru fed valve.

---

lowered room temperature control from 70°F to 60°F

EXP # 105 Repeat #104, (at lower temp)

	Liq. Level	Tad	Rod	Temp		
325	Start pumping					
339	17.5	17.14	20.02	.97545		
350	Sub critical					
	28.421	12.30	30.01	.98693	21.60 °C	Beck log N 3.1 x 10⁻¹¹
	Remove Source					Beck log N 1.5 x 10⁻¹¹
359	Drain thru feed valve to 13.651					

Add 98 ml of U^{233} solution to sphere

Drain remainder of solution to 0.00

Add ~~98~~ ml U^{233} soln to 2 liquid for 75 additional

EXP # 106 75 g Boron

	Liq. Level	Tad Added	Rod	Temp.	
430	7.8	17.14	20.01		
448	28.043	13.85	17.96	.9862 =	20.41

Beck log N ~1.5 x 10⁻¹⁰.

Source out and super by Ø8 rod at 17.9 c

9-11-58

Add 500 cc of H_2O Start Circulation @ 245 PM

EXP # 107 Stop " @ 401

4⁰⁰ PM 9-11-58 Beck log N = 4.2 x 10⁻¹²

Beck lin = 2.85 x 10⁻¹²

Keith = 2.9 x 10⁻¹²

~405 Start pump solution into sphere

	Liq. Level	Tad Added	Rod	Temp.		
430	28.043	15.52	19.66 ↓ 20.36	.9819 =	20.31	Super crit Pos Per
445	28.057	15.52	19.56	.98201 =	20.32	Appox Level
50	28.058	15.52	19.555	.98201 =	20.32	level

Drain thru feed valve.

---

add 500 cc of H_2O Start circulation at 510

Stop circulation 617

$$\frac{\Delta k}{\Delta \text{rod}} = \frac{3.127_0 \times 10^{-4}}{19.56 \rightarrow 20.36}$$

EXP # 108 9-11-58 Dorn c.c.

		liq lev	Tad adder	Rod	Temp		
6	18	Start exp. after mixing for 1 hr 6'					
	20						
		0.830	17.14	19.56			
	23	8.17	17.14	19.56			
	31	18.3	17.14	19.56			
	33	20.97	603				
	37	28.112	Sphere full Sub Crit with rod				
	37	28.112	14.67	19.56			
	43	28.017	14.67	21.80	~~.9852~~	Sub Nearly Crit	
	45	28.005	14.67	21.91	Nearly Crit.	Source out @ 2.5×10^{-11}	
	48	28.005	15.68	30.02		Rod Out	
	51	27.996	15.68	30.02	~~.9852~~	Pos Period	
	58	27.964	15.68				
				30.02	~~.9852~~		
7	07	28.199	15.68	23.73	~~.9852~~ .9858	Critical	= 21.31°C

Temperatures off because Std Rx not compared but it indicates that there is little drift.

↓

20.36 negative period too small too steep for any value as react meas.

7 11 Drain thru feed valve & shut down

#108 Sk = 1.44_2

Exp #109 (Repeat #108) 9-11-58 Dorn c.c.

~7	28	Start Solution back into sphere from ~ 1"				
		liq level	Tad Adder	Rod	Temp	
7	42	23.78	6.14	20.36		
7	47	28.008	14.65	30.03	.98523	Source out. Pos Period
		Calibrated	Beck	Log N		
7	53	28.003	14.65	30.03	.98531	Pos Period
	58	28.004	14.65	30.03	.98533	
7	59	Start to level				= 21.16
8	12	28.245	14.65	23.51	.98520	Level

Drain thru feed valve to Shut Down

Take samples with Pump running

8 58

$Sk = 1.63_{64} \times 10^{-4}$

Add 25 g U 100 cc 270 g/l + 50 cc H_2O

858 Start Pump Circulating Solution
Max Rate

10 03 pm Close Circ Valve – Barely cracked. Missed 1 hr 5'

EXP #110 ~100 g BORON

	Liq Level	Tad Assem	Rod	Temp.		
10 07	0.1	14.65	18.08			
13	11.7	14.65	18.08			
15	14.1					
20	20.5	14.65	18.08			
23 15	~~28.87~~	14.				
24	28.45	11.30	18.08	.9867	Sphere full	

Sub crit with Rod @ 18.08

31	28.011	11.30	~~24.08~~ 23.65	.98774	Source Out

Near Crit. @ 23.65 @ Back log N = 9×10^{11}

34 Start on Positive Period

40	27.989	12.07	30.02	.98776	} 21.83°C
46	27.980	12.07	30.02	.98786	
46	Start to level				
52	28.101	12.07	23.61	.98775	

Level

Drain solution thru feed valve

10 53

$Sk = 1.48_{13} \times 10^{-4}$ @ 21.83 °C

Set thermostat down 4°F

9-12-58 Took 6 samples after circ full rate ~15'
#41, #42 #43 #44 #45 #46

EXP #111 (Repeat of #110)

	Liq Lev.	Tad Adder	Rod	Temp		
4:34	0.15	17.14	19.00			

False period scram from resetting (delayed 1 minute) Period Meter Mixup.

4:40	0.1	17.14	19.06		
45	10.6				
50	16.7				

507 Super critical Sec on Pos Period

07	28.057	13.01	23.61	.97968	19.74 Pos Period 10 sec
13	28.048	13.01	23.61	.97970	
13	Start to level @ 2×10^9				

23	28.142	13.01	21.72	.9797	

$$\frac{\Delta \rho}{\Delta t} = \frac{3.2855}{21.83 - 19.74} = 1.57_2 \times 10^{-4} \qquad \$ = 3.2855 \times 10^{-4}$$

$$2.09$$

$$\Delta k_{total} = \begin{array}{r} 3.2855 \\ 1.4813 \\ \hline 4.7668 \end{array}$$

U-235 Bare & Cd Covered

Sept 12, 1958 EXP #112 Foil Run

	Higher	Tab added	Rod	Temp.
6[19] pm	0.00	17.14	10.43	
	Start Solution into Sphere			
25	12.1	17.14	10.43	
31	19.			

97905

Not enough excess react: to get on next exp period. Re inserted source Still rising,

6[45:30] Start timing exposure @ 2 $\times 10^{-10}$

51 Start to level ~ 5.5×10^{-10} → 6.0×10^{-10}

Remove source Solution temp = .97911

and insert Rod,

6 55	28.342	17.114	24.15	.97911
56			↓ 24.10	
57			24.05	

Level at 24.05 .97912

Drain tank @ 705 >0

Finis

Sept. 15, 1958

Measured height of solution = 50 3/16 in. ≈

Estimated volume slab Tank	140 ℓ
6' x 8" Cyl.	60 ℓ
	200 ℓ
In 2 ℓ bottle	1
	201 ℓ
12 sample bottles	1
Waste Solution	

Summary

	Purpose	T	ϕ x10⁴	k_{eff} @ 20°C
113		21.66	2.73	
112	Foil Run			
111	100g B Repeat of 110	19.74	3.2855 + 1.4813 = 4.7668	} 1.00043
110	"	21.83	1.4813	
109	75g B	21.16	1.6364	} 1.00032
108	"	21.34	1.442	
107	Sugar Cut 75g B			
106	" " 75g B			
105	Sub-			
104	Sub-			
103	50g B	25.32	3.800	} 1.00132 ± .00015
102	"	25.24	3.800	
101	25g B	24.11	4.866	} 1.00120 ± .00010
100	25g B	23.17	3.671 + 2.435 = 6.106	
	235			1.00118
	237 + 0 B			1.00065

EXP #113 (dark ppt of soln in neck
Dwn C.C. 8-18-58

	Lig Lev	Tad Calen	Rd	Temp	log N
402	Start soln	Source in			
405	0	17.14	20.02		$.9860_2$
410	10.6	.07	20.02		
13	14.2				
18	20.4				
28	26.527	.81	34.00		.98724
	On positive period Con N ~ 4.0×10^{-10}				
32	26.529	.81	34.00		2.7×10^{-10}
35	26.525	.81/4	34.00		8
37	30.015	11.51	34.00		$.98722 = 21.66°C$

Shut down by draining thru feed valve

Solution @ 26.53 $\rho = 2.1561 \times 10^{-4}$
" @ 30.02 $\rho = 2.7292$
Upper ppt $\Delta\rho = 0.5771 \times 10^{-4}$

.58

Lower ppt worth ~ 5.771×10^{-5}

$\frac{5.771 \times 10^{-5}}{2.588 \times 10^{-3}} = 2.23 \times 10^{-2}$ //

2.23 ϕ

4.4

Sept 29 Landsverk
140 mv recharged to 0

C.C Dev Pt

Sphere Calibration

Sept 29, 1958

On Tape 91.545
Bottom of Sphere 99.920

Regened selsyn
Bottom 0.000
Top 26.775

Rinsed lignin to ~ 33.055
Closed resin valve, tank valve
collect lignin can be drained from
Sphere into weighing bottle on scale

Lin to

Weight	Selsyn	wt	selsyn
2.30 kg	32.810	4.9	25.175
2.4	31.772	5.5	24.926
2.5	30.738	6.2	24.674
2.6	29.792	7.0	24.410
2.7	28.810	7.9	24.143
2.8	27.774	8.9	23.862
2.9	26.750	10.4	23.498
3.0	26.456	11.9	23.156
3.1	26.314	13.9	22.740
3.2	26.210	16.9	22.162
3.3	26.110	19.9	21.653
3.5	~~25~~.25.955	23.9	21.010
3.7	25.808	27.9	20.411
4.0	25.613	empty bottle	25 kg
4.4	25.408		

	wt	Selsyn
	2.30	20.411
	6.30	19.850
2	11.30	19.196
	17.30	18.447
	24.30	17.606
	EMPTY total 47kg	
	2.30	17.604
3	13.30	16.415
	24.30	15.184
	EMPTY total 69kg	
	2.30	15.184
4	13.40	14.017
	24.30	12,873
	EMPTY (total) 91kg	
	2.3	12.871
5	13.3	11.732
	24.3	10.541
	EMPTY 193 kg	
	2.30	10.541
	13.30	9.315
6	24.30	7.984
	EMPTY (135 kg)	
	2.30	7.983
	10.30	6.948
7	17.30	5.953
	24.30	4.810
	EMPTY (157 kg)	

	wt	Selsyn	
	2.30	4.810	
	8.30	3.655	
	12.30	2.671	
	14.30	2.051	
	15.30	1.663	
	15.80	1.443	
	16.30	1.176	
	16.60	.926	
	16.8	.786	
8	16.9	.768	
	17.0	.675	
	17.1	.568	
	17.2	.370	
	17.3	.227	17.32 °
	17.4	99.212	
	17.5	98.228	
	17.6	97.221	
	17.7	96,217	

Est Total wt

157

~~8.60~~

~~150.40~~

~~15.02~~

~~171.42~~ kg

T = 21.5°C = .9979

Sphere Volume =

$\frac{171.42 \text{ kg}}{.9979 \text{ gm/ml}}$ = 171.78 liters.

Est error. ~ 16 weighings involved $\Delta wt \approx 0.01$

$\therefore$ Total $\Delta wt \approx 0.04$ kg

$\therefore$ Sphere Volume = 171.78 ± 0.04 liters

Determination of Specific gravity of water from sphere using 100 ML PIPETTE

Gross 120.692

Tare 21.161

99.531

$\therefore$ Spec Gravity = 0.99531

~~171.42 = 172.22 liters~~

~~.99531 = 171.78~~

Ans 174.

Check Calibration of scale

5 kg	OK	.13
10 kg	OK	.60
15 kg	read 14.99	.04
20 kg	" 19.94	.77
25 kg	" 24.90	
28 kg	" 27.87	

$\therefore$ True wt = 171.42 − .79 = 170.63

			Correct
1st	27.9 - 2.9	= 25	±.13
2nd	24.3 - 2.3	= 22	±.09
3rd	24.3 - 2.3	= 22	±.09
4th	24.3	= 22	±.09
5th	24.3	= 22	±.09
6th	24.3	= 22	±.09
7th	24.3	= 22	±.09
8th	17.32 - 2.3	= 15.02	±.03
9th		172.02 + .70	= 172.7

Spec Grav. .99531

$$\text{Volume} = \frac{172.17}{.99531} = 173.5 \text{ liters}$$

9-30-58

D.F Cronin, Reedy & Hagmann calibrated sphere using

21 × 8l bottles

2 × 2l vol flask

+ 1.657 − .091 (in neck & 27.18)

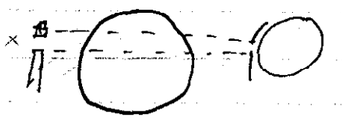
= 173.6 l.

3	30	27.18	essentially no leakage in 3 hr
3	40	27.18	
3	48	27.18	
4	03	27.15	

Average Vol = 173.55l

October 2, 1958

Removed float from liq level and painted bulb with rubber cement except for a vertical slit positioned over end photocell



so that the water column refracted the light off the cell as per suggestion of Jim Ellis. Tube was rotated so that its ends were in the plane of the screw and guide rod.

Pumped water up in tube to 21" and it followed both times. The adjustment is somewhat critical in order that the device works.

Calibration for 5lab storage tank

height "		wt of H_2O Kg
0.5"	=	5lab Zero
5 1/2"	–	32.20
9 3/4"	–	66.30
19 9/16	–	143.80
32 1/2	–	246.70
45 3/8	–	349.73
47 13/16	–	369.33
57 1/2	–	450.58
61 5/8	–	482.98

#114 Oct 22, 1958 DWM C.P

Repeat of U-235 run. added 7 25l bottle to system — measured volume > 180 l.

9[15] AM start Pumping solution into sphere. (recirc valve closed)

	liq. level	Tad Adder	Rod	Reflector Rod	Temp
9[20]	10.8	17.14	28.49	~~28.49~~ .01	
9[25]					

24.1 max height log N = 6×10^{-12}

Moved Reflector rod to 19.43 no change on log N.

Drain thru feed valve

#115 Oct 22, 1958 DWM CCP

Added ~7 1/2 l of solution from bottle 8 l expan vol 7 l crit vol

10[40] start solution in to sphere

50	16.95	.07	13.51	00.01	
~11[00]	Source out and critical				
10[04]	28.054	1.64	20.01	00.01	.9893 = Pos. Period
12	28.054	1.64	20.01 ↓	30.94	~~.9893~~ POSP
15			18.90	30.94	.98935 = ~~22.24~~ approx level
19			18.90	30.94	22.18 level

Drop power with safety rod 15.3

level at ~ 0.9×10^{-10} on log N Log N Calib OK

11[27]	28.107		18.77	30.94	Approx level
28 1/2	28.096	1.64	18.90 ↓	30.94	

#115 (Cont)

Using rod calibration 18.90 → 21.8 ¢ → 1.00140 = keff

Previous data @22.24°C 1.00071 = keff

∴ Using ~ 7½ l of more concentrated "soup" resulted in a gain of 0.00069 or 10.8 ¢.

11³⁴	level at log N ~8.8 X10⁻¹¹ move reflector rod in toward assembly					
11³⁶	28.088	1.64	18.90	00.01	.9893₀	Pos Period
11⁴⁵	28.087	1.64	18.90	00.01	.9893₂	"

Drain thru feed valve

22.72

Added 100 g H_3BO_3 + ~2.1 l of 300 g/L solution and drained ~5 l from system into 8 l. bottle for mixing the boric acid.

3²⁵ PM Powred into system and started circ pump.

4²⁰ Pump off.

#116 Oct 23, 1958 Dwn C.C

8²⁵	Start Solution in
8⁴⁹	Sub crit at 28 in sub crit. - Rf rod at 00.01 log N → 5. X10⁻¹² with source remove source
8⁵⁰	Shut Down - Drain Soln Thru feed Valve
10:¹⁰	Added 100 ml of 300 g/L Soln to system And started circ Pump
11:²¹	Pump Off

#117 Oct 24 Dwn C.C.

Repaired liquid level reader put in special float of J. Ellis.

342	Start pumping solution.					
50	Log Rev	Tad Adder	Safety	Reflector	Temp	
350	13.7	.07	21.51	00.01		
54						
57	Trouble with float.					
403	18.0	07	21.51	.01		
407	28.293	3.23	25.95	.01	.9913₇	Source in

Power rising log N ~ 1.3×10^{-11}

408+ Remove source. Sub crit but on measured negative period.

1st

22.76

421 Insert source Power to 2×10^{-11} A, .99 To 20.88 remove reflector rod

Power dropped slightly. 1.95×10^{-11} A

427 Remove Source 2nd Neg Period .99147

Oct 24, 1958 C.C.

9:00 AM Added 30 ML of 300 g/L soln to system
And started circ pump for Mixing

10:10 Pump Off

Oct 27 Exp # 118 Dewm C.C.

	liq level	Tad	Rod	Reflector	Temp
12:30 PM	Start solution into sphere				
32	5.3	17.14	00.27	30.95	
36	11.1	0.07	15.98	0.01	Log N
43	18.5	.07	15.98	.01	1.5×10^{-12}
45	20.9	"	"	"	1.8×10^{-12}
49	29.7	5.84	15.98	0.01	5.3×10^{-12}
		source out			Temp
56	28.949	7.20	30.12	.01	1×10^{-10} .9875 t Period
		Remove reflector rod			5.82×10^{-4}
58	28.949	7.20	30.12	30.94	1.5×10^{-10}
1:03	28.952	7.20	30.12	30.94	2.6×10^{-10} .98754
		Insert rod to level			3.28
05:20	28.979	6.25	22.28	38.94	
07			22.20		Super
			22.11		Sub-
			22.15		Critical .98758
1:14 PM		Drain thru feed Valve to			
1:38:15	1.58				T = 21.75

Interchange Beck and Keith Recorders

Repeat #118

Oct 27, 1958 #119 Dewm C.C.

	liq level	Tad	Adder Rod	Reflector Rod	
147	8.0	17.14	22.15	999.98	
156	17.4	.07	16.07	999.98	
	liq level not working. use visible sight on marker liq level ~~gauge~~ case.				
202	Sphere full				5×10^{-12}
207	On per. period source out ($\epsilon \, \nu \, N \, 1 \times 10^{-10}$)				
—	4.02	30.39	999.98	.9889	t Period $5.5.11$
211	Remove reflector rod				
2:17	— 4.02	30.39	30.95	.98896	t Period
	Insert Safety Rod to level				
225	— 4.02	22.49	30.95	.98897	Level
26½	Drain thru feed valve				

#50, 51, 52, 53, 54, 55 Samples removed after 4 L drained out bottom

Added ~ 30 ml of 300 g/L solution in an attempt to measure

$\frac{\Delta k}{k}$

$\frac{\Delta c}{c}$

3:40 PM addition completed and mixing started
4:20 Pump off
8:30 AM Oct 28, 1958 Pump started for Mixing

Oct 28, 1958 ~~#117~~ #120 Dwm c.c.

Detn of excess react due to 20 ml solution

	Liq Lev.	Tad	Safety Rod	Reflector	Temp	
10^{02}	21.05	00.07	14.02	999.98		
10^{09}	29.072	14.23	16.45	30.94	.9921 Sub crit	Source in
10^{14}	29.026	16.11	31.00	30.94	.99219	Pos Period Source out $\rho = 5.54 \times 10^{-4}$
10^{20}	29.018	16.11	31.00	30.94	.99220	
		Insert Rod To level				
10^{28}	29.206	15.58	21.18	30.94	.99210	Super critical
	29.206	16.58	21.13	30.94	22.95	Critical

11^{15} Added 40 ML of 300 g/L Soln to system And started Circ pump

11^{40} Stop Pump

12^{35} Start Pump.

1^{23} Stop Pump.

Exp #~~120~~ 121 Dwm cc.

(Detn of excess react due to 60 ml solution)

1^{27} pm	Start solution in.					
1^{30}	4.0	17.14	13.26	30.94		
35	11.5	.07	13.26	30.94		
1^{40}	17.3	.07	13.26	30.94		
45	~26.					
48	29.15	5.44	15.81	30.94	.99523	Subcrit
53	29.206	6.38	20.00	30.94	.9956	On Pos. Period $\rho = 3.60 \times 10^{-4}$
209	Start to Level					
215	29.251	6.38	19.06	30.94	.99552	Nearly level
218	29.251	6.38	19.06	30.94	.99557	Level

23.84

Oct 28, 1958 EXP #~~121~~ 122 Repeat 120 Dwm c.c.

	Liq level	Tad Adm	Safety Rod	Reflector Rd	Temp.		
259	Start solution into sphere						
3^{02}	7.1	17.14	13.07	30.94			
06	12.4	.07	13.07	30.94			
13	20.8	.07	13.07	30.94			
14	22.5						
16	29.2	4.83	13.07	30.94	.99459	Full	
3^{19}½	29.20	6.06	20.00	30.94	.99504	Source out + period	$\rho = 3.86 \times 10^{-4}$
33	29.206	6.06	20.00	30.94	.9951 2		
	level with rod						
40	29.257	6.06	19.00	30.94	.99510	nearly level	
45	29.257	6.06	19.00	30.94	.99515		

Drain thru feed T = 23.7

10-29-58 Add 50 ml of conc solution 298 g/l EXP #123

(Total excess act. is now 110 ml)

8^{55} Start Circ.

10:09 Pump Off

10^{44}	Start pumping solution					$\rho = 3.47 \times 10^{-4}$
11^{04}	20.5	17.14	1.32	30.94		not $\rho = \frac{28.55°}{26.27}$
11^{07}	21.6	.07	12.73	30.94		
11^{06}	Sphere full					
07	29.362	7.58	12.73	30.94	.99286	
08	(CRM on Ctr #3 has increased about 1 decade when Log N increased 1 decade)					
11^{15}	29.223	8.08	17.27	30.94	.99326	Pos Period
16	(CRM on Ctr #3 increased 2 decades when Log N increased 1 decades)					
	$(2.7 \times 10^{-10}$ on Log N = 500,000 c/m on CRM)					
20	29.220	8.08	17.27	30.94	.99326	Pos Period
	$(6.9 \times 10^{-10}$ = 850,000 c/m)				Start To level (T = 23.23°C)	
22			16.69 Sub			
37	29.245	8.08	16.69 Super	30.94	.99320	Level (continuous feed)

10-29-58 EXP # 124 (Repeat #123) SWM CC.

	Liq. Level	Tad	Safety	Rod (out)	
105 PM	99.308	17.14	16.69	30.94	
	Start solution in				
111	11.5	.07	11.91	30.94	
115	16.15	.07	11.91	30.94	
120	23.25	.07	11.91	30.94	
122	Sphere full				
127	On positive period source out → 3.88×10^{-4}				
127	29.243	12.66	12.27	30.94	.99242
140	29.24	12.66	17.27		.99250
	Start to level				
149	29.244	12.66	16.61	30.94	.99252 23.04 °C
150	Drain thru Feed Valve				

Total Volume of system ht = 47 3/4

Slab Vol 131.3

Cyl 60

191.3

10-29-58 EXP # 125 SWM CC.

Add 100 g + 2100 ML of Conc Solution (300 g/L)

3 15 approx start circulation mixing.

4 20 Stopped circulation

10-30-58

Liq level	Tad	Added	Safety Rod	Reff. Rod	Temp.	
923	Start Pumping Solution					
29	10.6	.07	12.09	30.94		
35	17.5	.07	12.09	30.94		
37	20.0	"	"	"		.98915 ≈ 22.16
944	Sphere full, rod out, subcritical					
	~ 3.8×10^{-12} on Beck lin. and Keithley					
	~ 7×10^{-12} on Beck log N					
945	29.100	17.14	30.82	30.94		
	Insert Reflector Rod					
	~ 4.2×10^{-12} on Beck & Keithley					
	~ 8×10^{-12} on log					

System is sub critical.

Oct 30, 1958 #126 Durdin .cc.

Added 143 ML Conc solution ~300 g/L

10[41] Started Circulation

11[58] Pump Off

3[30] Start Pumping solution

	Liq. Level	Tank	Sqrtn	Reflector	Temp
39	12.25	.07	13.16	30.94	
43	17.00	"	"	"	

55 Source out Rod out .99307 nearly critical at very low power, log N = 8.0 x 10^-12

enriched log N = 1.9 x 10^-11

57	29.80	13.20	31.22	999.97	
4[05]	29.280	13.20	31.21	999.97	.99

+ Period 3.76 x 10^-4

Remove Reflector Rod .99312

4[07]	29.279	13.20	31.21	30.94	T = 23.19	
4"	"	"	"	"	.99303	+ Period (system excess k)
4[16]	"	"	"	"	.99305	1.26 x 10^-4

Shut Down by draining thru feed valve

#118	100 g B	1.000338	T = 21.75	@20°	ρ = 7.58 x 10^-4
119	100 g B	1.000285	T = 22.14		7.99
*126	200 g B	k_{eff} = 1.000126	T = 23.19		7.66
*79,80,81	0 g B			@20°C	10.8

$\frac{\Delta C}{C}$ for 100 to 200 g B conc run

110 ml
2100 ml
143 ml
2353 ml of 298.10
20.15
277.95

$\frac{277.95}{20.15} \not\checkmark \frac{193.7}{2.353} = \frac{654}{3854.7} = 0.169_{67}$

October 31, 1958 #127 Dwn C.C.
(Repeat #126 207 g. Boron)

8⁵¹ Start pumping solution

	Liq Level	Tank Addn	Safety	Reflector	Temp
9⁰⁰		00.07	14.70	999.98	
9¹⁰	29.452	12.34	14.70	999.98	
	29.293	11.95			
	29.136	11.47			
	28.986	11.02			
	28.801	10.48			
	28.625	9.96			
	28.277	8.95			
	27.967	8.03			
	27.608	6.99			
	27.450	6.52			
	27.261	5.98			
.190 <	27.071	5.46			
.135 <	26.936	5.03			
.129 <	26.807	4.50			
.039 <	26.768	4.00			
	26.851	4.53			
	26.915	4.99			
	27.102	5.52			
	27.265	5.99			
Assumed top of sphere	27.085	5.50			

On positive period source out

9²⁸	27.075	9.10	30.08	30.94	.98835	#1 Pos Per. $+3.45\times10^{-4}$

Raise solution in sport. 21.97

	29.717	17.14	30.08	30.94	.98837	#2 Pos. Period $+3.81\times10^{-4}$

9³⁹ Drain Solution thru feed to shutdown Sprt ~ $.36\times10^{-4}$

Oct 31, 1958 #128 Dwn. C C
Added 45 g H_3BO_3 + 1060 ML of 298 g/l solution.

11¹⁰ Start Circulation Pump.
12²⁵ Stop Circulation Pump.

Source drive wheel cleaned, and spring tension increased to make source drive action more positive.

12⁴⁶ Start Pump

	Liq Level	Tank	Safety	Ref Rod		
1¹⁰	29.147	14.17	30.49	999.98	.99601	Sub crit.
1³⁰	Power raised to ~ 1×10^{-10} on B log N with source					
1³¹	29.140	14.17	30.49	999.98	.99552	
1⁴⁵	29.137	14.17	30.49	999.98	.99547	Neg Period 1.04×10^{-4}

Insert source to raise Power

1⁵⁸	29.135	14.17	30.49	999.98	.99540	

Remove source and Reflector Rod

2⁰⁶	29.134	14.17	30.49	30.94	.99541	=23.8° #2 Neg Period 3.30×10^{-4}

2⁰⁷½ Drain thru feed Valve

Lower Rm 113 temp from 70°F to 65° on setpoint in 112

Nov 3, 1958 #129 Repeat of 128
at lower temp so that the system should be critical.

	Liq Level	Rod Ladder	Safety	Reflector	Temp	
901	Start solution into sphere					
903	2.2	17.14 ↓	14.03 ↓	30.94		
905	6.7	0.07	16.00	30.94	.97676	
915	19.2	.07	16.00	30.94		
920	29.02	Sphere full, start rod out.				
921	28.91	13.10	19.03	30.94	.97824	
		Source out on positive Period				
924	29.33	15.93	30.17	30.94	.97832	16 Sec 4.20×10⁻⁴
935	29.71	15.93	21.53	30.94		T = 19.38°C
939	29.73	15.93	21.31	30.94	.97837	
946	29.72	15.93	21.32	30.94	.97835	= 19.38 °C
950	Shut down by draining thru feed valve					

Nov 3 1958 #130 Repeat #129

	Liq Level	Rod Ladder	Safety	Reflect.	Temp	
1224	Start Solution into Sphere					
28	9.0	17.14				
35	16.8	17.14 ↓	16.00	30.94	.97994	
37	19.55	0.07	16.00	30.94		
45	Source out on Pos Period					
49	29.341	13.77	30.03	30.94	.97961	$\rho = 3.09 \times 10^{-4}$
53	29.333	13.77	30.03	30.94	.97956	T = 19.69°C
54	Shut down by draining thru Feed Valve					

Mounted #3 discs Cd Cover #1 1" above center
(center = 31.25 below Top (18" + 13.25))
in Polystyrene holder weighted down with SS nut
16" from center therefore in inlet tube.

Mounted #2 bare U-235 foil 1" below center

Nov 3, 1958

Run # 131 (Foils U-235 bare & Cd Covered)

2 28 Start Solution into Sphere

	2.8	Tadiller	Safety	Reflector	Temp
2 37	13.3	17.14	21.81	30.95	
		↓	↓		
39	15.	.07	19.01	30.95	
43	20.4	"	"	"	~ 20.14°C
50	29.228	12.45	30.14	00.00	.98139 only slight super

with comment. Not enough excess Reactivity to get on positive period with cadm foil in center

Insert source. this will not get us to high enough power so shut down

254 Drain thru feed valve

Set room thermostat down to 63°F (was 65)

Run #132 Nov 4, 1958 Dwgs ⊙ c

U-235 Foils Cd covered #3 1" above ℄

" Bare #2 1" below

Log Level Tad [illegible] Ref. Temp

147 2 Start Solution into sphere

149	1.75	17.14	30.0	30.95	
155	6.5	0.07	18.48	30.95	.97239 →
200	17.8	.07	18.48	30.95	

210 Rising on positive period with Source in

210	29.152	13.60	29.71	00.03	.97416

2 1430 Start timing foil exposure at Log N = 1 (10⁻⁹)

Level at log N = 2.7 x 10⁻⁹

2 22	29.508	13.60	22.40	30.95	.97426
			↓		
28			22.37		level on linear inst.
30	29.5	13.60	22.37	30.95	.97421
			↓		
30			22.34		.9-
34					.97418

34½ Start dumping solution thru feed.

Calibration Check OK

Nov 7 Temp set point increased from ~62 to 67°F

Removed Safety Rod, installed rod for moving miniature counter thru the ~~a~~sphere. N.B. that the only safety is the fuel dump, a secondary would be draining thru feed valve with pump off.

EXP # 133 Nov 7, 1958

~~Set temp~~

9:09 start Solution

Checked for leaks at ~2" and 9" heights since the sphere flanged was loosened when the foils were dropped at end of run #132

9:35 Super Critical

rev/min	rad		repeater	
29.163	11.71	X	30.95	.9813

2' min counts	C_1	C_2	C_3	start log N	exp log N
~9:37	29x256 + 50	156x16+13	117x256+172	5×10^{-11}	
	93 +131	234 +5	173 223	7×10^{-11}	
	64 +225	348 +14	260 + 328	1.1×10^{-10}	
9:45.00	107 +75	568 +11	430 +135	~1.8×10^{-10}	Temp
9:48:00	182 +109	x64 245 +35	738 +57		.9813
	312 +9	420 +31			20.14

Level with Rad Adder

26.456	0.48
26.453	0.40
403 +254	536 +37

8×10^{-10}

excess reactivity ~ 2.2×10^{-4} → 20.14

Changed thermometer ~2°F

Counter Position ~~as~~

Selsyn Reading 50.05 down, out of

Counter Tip ~ 4 1/16" from Top of Sphere

Counter reading to top of sphere 3 1/2"

Counter down distance @ 16.66 7/8"

Counter tips 2 5/8" below

sphere when reading is 16.66

lowered to 16.01

Counter was well centered in top and lower holes in the sphere.

Exp #134

#5 - 2 Counter traverse. dWn C.C.

2:38 Start Solution into sphere Temperature change not effective ~ solution critical source out

			Counter	Rod	Temp	
3:06	26.406	.07	16.00	30.95	.98296	Start Sub
08	26.454	1.06				Sub
10	26.502	2.07				Level
12	26.551	3.07				Super
14	26.608	4.08				
16	26.668	5.07				
18	26.717	6.07			.98305	
20	26.797	7.07				
24	26.918	8.06				

Raise Power to ~ 1.3×10^{-9}

with Reflector Rod Counter Rad Adder to .07

25	26.402	.07	16.00	2.71

EXPE

	C_1	C_2	Pos.	Level	Rod Reflector	C_2 Position
3[27]				26.396	4.66	16.00
30	1288 x256 +228	224x16 +8	1'	26.393	6.86	
31-	672 +97	224 x16 +9	2'	26.388	6.66	17.00
			2'		7.10	18.00
				26.385	7.10	19.00
					6.12	20.00
				26.383	5.40	21.00
~344					4.91	22.00
				26.381	3.08	23.00
~350					3.08	24.00
		Temp. 98302		26.383	2.63	25.00
					1.94	26.00
~6:00:30					1.41	27.00
					1.41	28.00
					1.41	29.00
~4:06					1.41	30.00
					1.41	31.00
				26.376	1.41	32.00
					2.33	33.00
					2.95	34.00
419					4.03	35.00
		Temp. 98307			4.94	36.00
					6.13	37.00
427					8.01	38.00
				26.371	10.88	39.00
		drain thru feed valve		26.340 26.337	13.64	40.00

RI MENT #134 (cont)

C_1	C_2	C_1	C_2	C_2/C_1
→ 1288 x256 +228	224x16 +8	329 956	3592	.0109
672 x256 +97	224 x16 +9	172 129	3593	.0209
666 +218	479 x16 +3	170 714	7667	.0449
655 +99	190 x64 +46	167 777	12 206	.0728
641 +130	270 x64 +48	164 226	17 760	.1081
627 +234	345 x64 +59	160 746	22 139	.1377
605 79	409 x64 +9	154 959	26 185	.1690
597 +39	474 +23	152 871	30 359	.1986
587 +144	532 +29	150 414	34 077	.2266
572 +121	581 +58	146 553	37 242	.2541
561 +74	624 +8	143 690	39 944	.2780
560 +241	167 x256 +5	143 601	42 758	.2977
569 +200	178 +218	145 864	45 786	.3139
569 +28	184 +212	145 692	47 316	.3248
576 +119	190 +107	147 575	48 747	.3303
584 +72	193 +48	149 576	49 456	.3306
604 +214	197 +42	154 838	50 474	.3260
622 +144 156	197 +100	159 388	50 532	.3170
631 +162	190 +95	161 698	48 735	.3014
644 +55	183 +227	164 919	47 075	.2854
652 +221	170 +151	167 133	43 671	.2613
674 +133	158 +0	172 677	40 448	.2342
705 +104	145 +211	180 584	37 331	.2067
742 +177	517 x64 +16	190 129	33 104	.1741
763 +132	436 +37	195 460	27 941	.1429

436

	Tad	liq level	
drain then feed	.44	26.294	41.00
	.44	26.285	42.00
	.44	26.280	43.00
	.98	26.315	44.00
			45.00
	.98	26.299	~~44~~.00
			~~47~~
			~~48~~
			~~49~~
			~~50~~

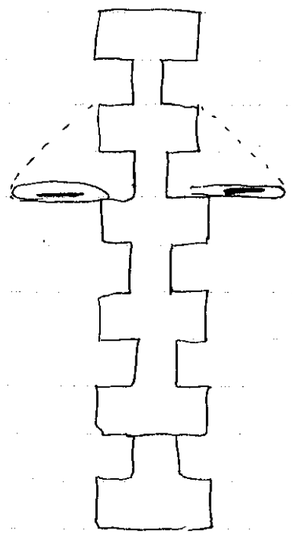
3 MIN Background

P_1	C_2	C_1 C/MIN	C	
721 X256 +180	321 X64 + 16	184 856	20,560	.1113
699 21	201 +58	178 965	12 922	.0722
668 +118	87 +13	171 126	5 581	.0326
~~696 +232~~	~~14 +4~~	X		
658 +236	13 +12	168 684	844	.0050
666 +243	19 +47	170.739	1263	.0074
0 +113	0			

Probably delayed Neutrons

#135 Nov 10, 1958

Determination of Cadmium Fraction at a different position, foils suspended on polystagrene foil holder with polyethylene bag.



#3 Cadmium Covered
#2 Bare.

log N @ 1.35×10^{-9}

	liq. Lev.	Tal Addn	Reflector Rod	Temp		
1^{27} PM	Start Solution into sphere					
1^{50}	29.117	13.58		.02	98275	Source out + Period 163 sec or 4.22×10^{-4}
1 59	Start Timing		log N = 5×10^{-10}			
2^{04}	26.538	1.94		30.95	.98375	Sub
2^{09}	26.529	1.93 ↓ 1.82 ↓ 1.62		30.95	.98270	1.35×10^{-9}
13		1.52				
18	26.506	1.52		31.25	.98274	
2^{19}	Shut down by draining solution			T = 20.50°C		

excess k = 4.22 − 2.44 = 1.78×10^{-4}

Nov 12, 1958

~~Nov 11, 1958~~ #136 Repeat of Run #134

Gwin taped U-233 capsule to side of sphere for activation.

#5-2 fission counter traverse starting at setup reading of 16.00 which is decreased inches below neck.

	Liq level	Tal Addn	Counter	Reflector	Temp	Power
1^{38}	Start Solution					
1^{44}	10.427					

Stopped to check C_2 — — dead with large neutron source.

2^{00}	29.021	12.09	16.00	00.02	.98426	pos Period
2^{06}	log N @ 5×10^{-10}	Start Timer (Gwin fill exp.)				
2^{06} 2^{10}	29.021 level 26.880	12.09 .07			.98397	

Position		$C_1 \times 64$	$C_2 \times 64$	C_1	C_2	C_1/C_2
16.00	2^{11}	60 +1	35 +21			
17.00		66 +1	74 +5			
18.00	2^{17}	69 +51	177 +31			
19.00		73 +35	319 +42			
20.00	2^{22}	77 +5	454 +56			
21.00						

Counter Inserted

Continue run until 3^{10} so that the 233 capsule gets 1 hr irradiation

3^{10} Drain thru feed valve

#137 Nov 13, 1958 DLSM cc.

	liq ler.	Tad	Counts	Reflecto	Temp
909	Start pumping solution				
930	Sphere full Source out Slightly open				
	29.090	11.58	16.00	30.95	.98315
933	On Positive Period			0.03	
944	Start to level				
948	26.381	.08	16.00	30.94	
52	26.369	.08	18.00	30.94	
1000	26.420	.82	21.00	30.94	
1006	26.441	1.37	23.00	30.94	
1008	26.473	2.18	24.00	30.94	
1014	26.5	3,00	26.00		
1017	26.539	3.53	27.00	30,94	
1027	26.495	3.00	31.00	30.94	
30	26.461	2.53	32.00	30.94	
36	26.4	1.21	34.00	30.94	
40	26.386	.72	35.00		
45	Dump some thru feed valve				
47	26.324	.50	37.00		.98319
51	26.308	.50	38.00		
53	26.28	.08	39.00		
	Dump out thru feed valve				
1101	26.251	.08	42.00		

Counting Data

#137-1 & 2

TIME	C_1 x256	C_2 x256	C_3 x256	POS	TIMER	C_1	C_2	C_3	C_3/C_1	C_3/C_2
9:48	639 +48	595+199	8+174	16.00		163,682	152,519	2,222	.01358	.01456
~9:50	628 +13	605+113	18+50	17.00		160,781	154,993	4,658	.02897	.03005
~9:53	615 +143	609 +19	39+153	18.00		157,583	155,923	10,137	.06433	.06501
~9:55	615 +0	612 +141	66 +74	19.00		159,440	156813	16,940	.10629	.10821
	610 +154	603 +113	93 +4	20.00	119.7	156,314	154,481	23,812	.15233	.15414
Scaler Reg. →	620 +129	601 +97	120 +64	21.00	119.7	158,849	153,953	30,784	.19379	.19995
	591 +218	583 +105	144 +212	22.00	—	154,514	151,913	37,076	.24028	.24406
~10:06	587 +148	589 +1	169 +112	23.00	120.0	150,420	150,285	43,396	.28836	.28766
	593 +164	596 +175	195 +92	24.00	120.1	151,992	152,951	50,012	.32908	.32740
	592 +158	593 +143	216 +188	25.00	120.2	151,710	151,851	55,484	.36572	.36538
	604 +136	598 +35	235 +164	26.00	119.7	154,760	153,123	60,324	.38979	.39395
	612 +197	614 +201	259 +251	27.00	240.0	156,869	157,385	66,555	.42427	.42288
	631 +202	627 +17	280 +161	28.00	120.0	161,738	160,529	71,841	.44418	.44752
X →	648 +196	642 +129	296 +223	29.00	120.2	166,084	164,481	75,999	.45759	.46205
	665 +86	655 +241	311 +7	30.00	120.2	170,326	169,921	79,623	.46747	.47416
	667 +177	663 +91	312 +229	31.00	120.3	170,929	169,819	80,101	.46862	.47168
	659 +5	655 +129	305 +174	32.00	120.2	168,755	167,809	78,254	.46391	.46632
10:33	671 +240	670 +3	302 +117	33.00	120.2	172,016	171,523	77,429	.45013	.45142
	676 +161	674 +163	288 +207	34.00	120.2	173,217	172,702	73,935	.42683	.42809
	675 +190	671 +17	270 +176	35.00	120.8	172,990	171,793	69,296	.40058	.40337
10:43	683 +10	681 +81	253 +65	36.00	120.2	174,858	174,417	64,833	.37077	.37171
10:47	658 +12	651 +163	217+174	37.00	120.2	169,460	166,819	55,926	.33080	.33526
	659 +143	641 +137	189 + 6	38.00	120.2	168,847	164,233	48,390	.28659	.29464
	653 +243	645 +129	160 + 98	39.00	120.2	167,411	165,249	41,058	.24525	.24846
	646 +158	636 +179	127 +141	40.00	120.4	165,534	162,995	32,653	.19726	.20033
X →	643 +188	627 +49	96 +208	41.00	120.2	164,796	160,561	24,784	.15039	.15435
	646 +124	630 +131	65 + 231	42.00	120.0	165,500	164,411	16,871	.10194	.10452
	660 +225	646 +121	28 + 34	43.00	120.3	169,185	165,499	7,202	.04257	.04351
	667 + 83	653 +121	6 + 190	44.00	119.9	170,835	169,289	1,726	.01010	.01032

#137 -1 -2

WCX-885 (Jan'48) Y-12 DATA SHEET

#138 DWM C C. Nov 13, 1958

110 Start Pumping solution

Counter U-235 #3 was suspended in sphere pointing at large an oblique angle as permitted by the 18" neck this counter is to be used for the reference counter. The moving counter does not touch it.

Top of #3 is 32" from Top of ~~neck~~ sport or 14" from top of sphere, approx 3-4" from center.

	level	Tad	Counter	Reflector	Temp
123 1149 PM	19.5	0.07	16.00	00.03	
125	22.75	"	"	"	.98435

Leave source in while going up in power to assist in getting to power quicker.

138 Power level ~ 7.5×10^{-10}

29.020	7.21	16.00	00.03	.98435

142 start leveling. ~ 2×10^{-9}

147 26.865	0.69	16.00	.03	30.95
150 26.852	0.69	16.00	.03	30.95
151 26.775	0.07			
201 26.762	0.07			7.55

Counts taken @ 1" intervals for 2 min with travelling fission counter

206 26.760	.07	~~22~~.00	.03	4.93
		23.00		4.06
		24.00		2.98
		26.00		2.49
		27.00		2.21
		31.00		2.50
231		32.00		2.02 .98430

	level	Tad	counter	Reflector Rod	
234	26.747	.00.07	33.00	3.87	
236	26.745	.07	34.00	5.01	
			35.00	5.96	
			36.00	10.75	
		Dumped some solution thru feed valve			
249	26.5288 ~~26.5~~	1.50	37.00	2.11	
251	26.524	1.50	38.00	2.91	
254	26.521	1.50	39.00	4.03	
259	26.518	1.50	40.00	5.01	
259	26.517	1.50	41.00	7.00	
			42.		
			43.		
			43.		
310	26.514	1.50	42.00	7.00	
12	26.515	1.50	41.	6.00	
			40.00	5.00	
18	26.516	1.50	39.00	3.90	
21	26.517	1.50	38.00	3.90	
			37.00	2.95	
26	26.519		36.00	2.08	
	26.521		35.00	1.01	
	.523		34.00	1.01	
	26.524		33.00	.42	
	.524		32.00	.66	
	.524		31.00	.40	
			30.00	.21	
	.524		29.00	.32	
			28.	.32	
			27.	.32	
54	.525		26.0	.32	
			25.0	.40	.98436
58	.525		24.0	.74	
	.525	1.50	23.0	1.01	
			22	1.01	
406	.525	1.50	21.0	1.39	
			20.0	1.78	
412	.527	1.50	19.0	2.00	
414	26.528	1.50	18.0	2.00	

Run #138

Counting data

~~Position~~ Position	C_2 x256	C_3 x256	C_2	C_3	C_3/C_2	
43.0	280 + 22	58 + 85	71,900	15,698	.21833	
42.0	280 + 102	109 + 171	72,400	29,614	.40934	
41.0	279 + 133	154 + 106	72,154	40,484	.55645	
40.0	282 + 182	199 + 221	74,012	53,159	.70467	
39.0	281 + 130	256 + 175	73,236	67,286	.91895	
38.0	279 + 190	286 + 225	73,524	75,466	1.0292	
37.0	273 + 85	318 + 132	70,738	82,728	1.1695	
36.0	267 + 118	346 + 161	69,238	90,186	1.2990	
35.0	272 + 55	383 + 216	70,182	100,208	1.4278	
34.0	274 + 157	412 + 59	71,114	106,024	1.4789	
33.0	279 + 196	439 + 232	73,284	114,704	1.5631	
32.0	276 + 13	444 + 172	70,786	115,384	1.6300	138-2
31.0	272 + 149	446 + 208	71,032	116,256	1.6346	
30.0	276 + 143	448 + 253	72,086	117,218	1.6261	
29.0	270 + 49	434 + 77	69,610	111,876	1.6071	
28.0	266 + 203	409 + 207	70,126	106,774	1.5226	
27.0	261 + 84	385 + 205	67,652	100,610	1.4821	
26.0	263 + 234	362 + 164	69,668	94,312	1.3537	
25.0	265 + 244	339 + 120	70,260	88,184	1.2519	
24.0	273 + 184	306 + 107	71,728	79,106	1.1020	
23.0	271 + 150	267 + 93	70,806	69,282	.97851	
22.0	271 + 253	226 + 123	71,966	59,086	.82101	
21.0	272 + 156	184 + 78	71,192	46,284	.64260	
20.0	271 + 3	141 + 110	69,406	37,196	.53591	
19.0	271 + 79	98 + 30	70,166	25,388	.36183	
~~47.0~~ 18.0	272 + 213	56 + 63	71,762	14,966	.20855	
~~46.0~~						

Position	~~C_1~~	C_2 ×256	C_3 ×256	C_2	C_3	C_3/C_2	
16.00	Beds.	298 +238	11 +2	76,526	2,818	.03682	
17.00	lin.	298 +234	23 +122	76,522	6,010	.07853	
18.00		307 +103	61 +117	78,695	15,733	.19992	
19.00	$5.8 \times 3 \times 10^{-9}$	281 +222	105 +108	72,158	26,988	.37401	
20.00	$5.75 \times 3 \times 10^{-9}$	286 +112	148 +54	73,328	37,942	.51743	138 - 1
21.00	5.72	286 +134	189 +236	73,350	48,620	.66285	
22.00	5.65	279 +91	229 +121	71,515	58,745	.82144	
23.00	5.60	270 +112	266 +152	69,232	68,248	.98579	
24.00	5.65	277 +179	308 +157	71,091	79,005	1.11132	
25.00	5.68	275 +91	345 +28	70,491	88,248	1.2533	
26.00	5.65	271 +222	376 +175	69,598	96,431	1.38555	
27.00	5.65	273 +87	403 +88	69,975	103,256	1.4756	
28.00	5.68	274 +254	425 +132	70,398	108,932	1.5474	
29.00	5.68	272 +227	439 +185	69,859	112,569	1.6114	
30.00	5.70	272 +106	447 +138	69,938	114,570	1.6429	
31.00	5.75	277 +205	451 +243	71,117	115,699	1.6269	
32.00	5.80	276 +167	449 +118	70,823	115,062	1.6246	
33.00	5.80	277 +233	437 +188	71,145	112,060	1.5751	
34.00	.	280 +228	419 +115	71,908	107,379	1.4933	
35.00		274 +241	391 +114	70,385	100,210	1.4237	
36.00		270 +188	356 +49	69,308	91,185	1.3156	
37.00	~~5.68~~ 5.70	275 +168	322 +160	70,568	82,592	1.1708	
38.00	5.77	275 +99	285 +90	70,499	73,050	1.0362	
39.00	5.80	279 +157	243 +124	71,581	62,332	.87077	
40.00		278 +96	198 +8	71,264	50,696	.71138	
41.00		275 +226	153 +9	70,626	39,177	.55471	
42.00		275 +61	108 +142	70,461	27,790	.39440	
43.00		277 +253	57 +61	71,165	14,653	.20590	
44.00							
45.00							

139

11-20-58 C.C - R.G

Source in Bldg. Alarm set

2:20PM

Purpose - activate 2 U^{233} filled plastic capsules. # 7_T + 12_T.

12_T cd. covered

7_T bare

the capsules are ~~2 5~~ $2\frac{3}{8}$ on either side of the center of the sphere.

liq level	+ A	Ref Rod
29.027"	8.34"	6.18
28.984	8.34	0.63

I 1:54

3 1:57

Raise cd covered foil ~~from~~ 8.42" to

Raise ~~increase~~ Power level

Power level ~ 5×10^{-9} Lin N

Capsules inverted → neg period.

3 ~~:50~~ Shut Down by Draining soln thru feed valve

4:19 lower temp in RM # 113 to 65°

140

11-21-58 C.C. R.G.

12 5:55PM Source in Inst Response IC 1, 2, 3, and 4

radiate 2 U^{235} capsules

1 cadmium covered

1 bare

liq level	+ A	Ref Rod	temp
91.785	17.14	30.94	
26.332	0.07	30.94	(source out) Super crit
26.338	0.07	30.94	.9732

Power level log N 1.3×10^{-9}

" " log N 5.0×10^{-9}

1 37 26.050 0.07 30.94

1 54 26.046 0.07 30.94 level

Power level log N 6.0×10^{-9}

2 01 Shut Down Drain Soln thru feed Valve

2 04

2 18

1 15

8:58 AM

141 11-25-58 R.G CC

Source IN Inst Response - IC - 1 - 2 - 3 and 4
Capsule Exposure 1 Cd Covered
1 Bare

	lig level	+A	Refl Rod	temp	
	91.778	17.14	30.94		
9 46	26.248	17.13	30.94		Pos Period
9 45					$\ell_N N = 5 \times 10^{-9}$
9 44					$\ell_N N = 6 \times 10^{-9}$ +
9 47	log N	Power level	5.8×10^{-9}		
	25.813	2.58	30.94		Approx level
10 15	drain fuel				

142 11-25-58 R.G. C.C.

to measure the reactivity of the fabricated aluminum cap

1 58 PM Source in - Inst Response IC - 1 - 2 - 3 AND 4

	lig level	+A	Al Cap	Refl/Rod	~~temp~~	
	91.757	17.14	14.93	30.95		
2 42	25.878	14.41	14.93	30.95		Pos Period
3: 25	25.615	5.54	30.62	30.95		Approx level
3: 28	25.613	5.54	14.95	30.95		Pos Period
3: 42	25.613	5.54	31.62	30.95		Approx level
3: 48	Shut Down	Drain	Soln			

↓ worth of alum shell 2.18×10^{-4}

Removed paraffin block on reflector rod so that alum-shell can be raised an additional "16". Upper limit before wires touch upper structure ~47.65 lower limit shell in contact ~15.65 ∴ Shell can be raised 32", approx 16" higher than previous run #142. Run Temp (thermostat) was changed 5° F however room temp didn't respond and run Temp is only ~68° F or 20° C.

Run # 143 11-26-58 DLOM CC

9 15 Source in, Tripo set, start feeding solution

	lig level	rod adder	Al Shell	Temp (thermistor removed) (Run Temp°)	
9 18	4.2	17.14	15.35		
9 33	24.0	.07	15.35		
9 35	25.896	.07	15.35	.9800$_6$	Source out. Super
9 41	Remove shell and drain solution in order to level				
	log N ≈ 7×10^{-4}				
9 48	25.768	.44	47.66 ↓		level
		lower shell			
9 50	25.764	.44	15.29	(cools slash) .9799$_8$	+ Period
10 00	25.761	.44	15.29 ↓		$\rho = 2.37$
10 01	Lift Shell		47.65		$T = 305.7$
10 10	25.762	.44 ↓ .30 ↓ .26	47.65		Super Crit slightly
					$\beta = 0.22 \times 10^{-4}$
					$T = 5985$ sec
10 22	25.749	.19	47.65 ↓ 31.60 ↓ 47.66		level slight + period $\rho = .06$ $T = 20,740$

143 (Cont) D₂O m.c.c.

	liq level	Tad Adder	Shell	
1033	25.749	.19	47.66	level
1036		.19	15.65	Pos Period
1048	25.750	.19	47.66	ρ = 2.27
1058	25.750	.19	47.66	T = 332.5 sec
1059	Drain thru feed Valve			level

Calculation of average Al thickness in Al shell cap for react meas.

Area of cap = $2\pi rh$ = 6.28 × 35 × 8.81

= 1936.4 cm² × 2.54 = 4918 cm²

Wt = 4.06 kg

Alum = $\frac{4.06}{4.918} = \frac{0.826}{}$ gm/cm²

Al density = 2.7 g/cm³

∴ Alum thickness = $\frac{0.826}{2.7}$ = 0.306 cm

= 0.120"

Area of complete sphere = $4\pi R^2$ = 37610

4

15,044

∴ Total worth of shell is $\left(\frac{15044}{4918} = 3.06\right) \times 2.27 \times 10^{-4}$

$\rho = 6.95 \times 10^{-4}$

27" Sphere Diam Meas (Calipers + Steel Rule)

1 - 27 3/8

2 - 27 3/8

3 - 27 1/4

4 - 27 7/16

5 - 27 17/32 (Horiz Diam)

6 - 27 3/8

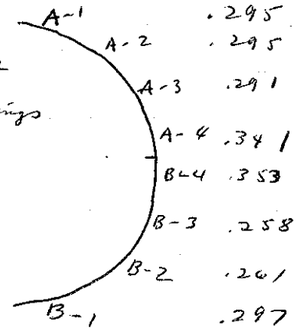
7 - 27 7/16

8 - 27 7/16

9 - 27 7/32 (Vert Diam)

FOUR FOOT SPHERE

Thickness measurements from reflectoscope readings



Total weight 114.3 kg

3 legs 57" } 2" Al Angle. ¼" @ 1.12 lb/ft = 26.88 lb.
3 braces 39" }

~~12.3 kg~~ 12.19 kg

3 plates ¼" x 6" x 8" = 36 in³ = 589.68 → 1.60 kg

13.8 kg

Sphere weight 100.5 kg

2 Flanges
2 ft 3" Al tubing } wt 3 kg

Assume Diam = 4' r = 61 cm

Area = $4\pi r^2$ = 46,760.

wt = $4\pi r^2 t \rho$ = 126720 t

average t = $\frac{100.000}{4\pi r^2 \rho}$ = 0.789 cm

= 0.311 inches

dwm 12-1-58

~~thickness~~

Diameter measurements with 48" Micrometer

		dev			dev
A_0	48.582	.073	B_1	.711	.056
A_1	.724	.069	D_0	48.642	.013
A_2	.623	.032	D_1	.677	.022
A_3	.620	.035	D_2	.555	.100
A_4	.822	.167	D_3	.596	.059
B_4	.867	.212	D_4	48.683	.028
B_3	.616	.039	E_4	48.787	.132
B_2	.710	.055	F_4	.642	.013
			F_3	.496	.159
			F_2	.502	.153
			F_1	.671	.016
			F_6	.650	.005

$C_4 = 48.681$ (dev .026)

cc · wet Dw 12-1-58

Average Diam 48.655 $\Sigma |d| = 1.464$

$\Sigma d^2 = .175_{012}$

$\sigma = \left(\frac{\Sigma d^2}{n}\right)^{1/2} = \left(\frac{0.008334}{}\right)^{1/2} = 0.0913$

O Diam = 48.655 ± 0.091

.66 ± .09 Average wall .303

48.66 − .61 = 48.05 2 d = .61

measured I D ~ 48.05"

Volume average Radius = 24.00

THREE FOOT SPHERE

AVERAGE WALL THICKNESS

By blowing hemisphere from flat sheet the area is doubled $\pi r^2 \longrightarrow 2\pi r^2$ and hence thickness must be halved. ∴ For 3' sphere the average plastic wall thickness must be 1/4" since 1/2" sheet was used to make the hemispheres.

Dw 12-1-58

December 4, 1958

37½% enrichment

Obtained 15 liter bottle from DF Cronin labeled as follows

Conc 37½ drawn off 9-24-58 before diluting

η 0.44 gm U/gm

Spg Gr ~1.9

Container tare labeled 2.713

Gross weight on Toledo Rm 113 29.27 kg

Tare 2.71

26.56 kg Solut

Analyses	gm U/gm	density
①	.44997	2.0452
②	.44921	2.0434

.44959 × 2.0443 = .9191 gm/ML

× 26.56 = 11.941 kg U × .3701

.3802 gm 25 ML

Assay

4	0.28
5	37.01
6	.29
8	62.42

× .3701 = 4.419 kg U-235

∴ $\frac{3.3}{4.4}$ = ~75% of the Uranium solution is needed to get critical

12-5-58

EXP # 144 Dump ce

~ 30% enrichment in 27" sphere

Added 175 l H_2O to Tank

added 3/4 of solution in Bottle ~ 3.3 kg U-235 over an hour period, circulation continued while pumping solution into system.

16^{30} Start circulation wide open.

10^{55} STOP " "

	liq lev	Tad Adder	Reflector Rdd	Log N	Log N	Beck
11^{00}	1.90	17.14	30.95			
03	5.0	.07	999.98			
11^{23}	29.258"	5.65	999.98			
11^{25}	Sub Crit	T = .99735		2.3×10^{-12}	6×10^{-12}	$.6\times10^{-12}$

Add approx 400 ml in tubing.

(180 ml / 5" x 2 1/3) = 420 ml

12^{00} Start circulation

10^{7} Stop "

EXP #145

1^{09} Start Pumping solution into sphere

				Temp.	
1^{19}	10.75	17.14	~~30.95~~ 999.98		
1^{16}	12.85	.07			
1^{36}	29.087	8.26	999.98	1.00013, ~~.99~~	Subcritical —

log N = 3×10^{-12}

Enriched log N = 6.7×10^{-12}

Beck = 1×10^{-12}

Kettley = $.9\times10^{-12}$

Remove Reflector Rdd to 23.85 No change in Inst Mult.

Exp # 146

Add approx. 150 ml conc UO_2F_2 soln.

2'50m Start Circulation

3:03 Start Pumping soln into sphere

liq level / tA / Refl Rod / temp

91.705 / 17.14 / 99.997

Source in / Inst Response / IC 1, 2, 3, 4

3:27 29.028 / 4.26 / 99.997 / Sub Critical

log N (C - 7×10^{-12}

Enriched log N - 2.8×10^{-12} / 1.00282

BeckMan - $.9 \times 10 \times 10^{-12}$

Keithley - $.8 \times 10 \times 10^{-12}$

3:34 Drain soln thru feed valve

12-8-58 Exp # 147 R.G. CC

Added Approx 100 ML of Conc UO_2F_2 soln

9:35 start circulation

liq level / tA / Refl Rod / temp

91.699 / 17.14 / 99.997

10:43 Source in / Inst Response / IC 1-2-3-4

11:17 29.006 / 10.01 / 99.997 / Sub critical

log N - 3.5×10^{-12} / .8515

Enriched log N - 9×10^{-12}

BeckMan - ~~$1.2 \times 10 \times 10^{-12}$~~ $1.2 \times 10 \times 10^{-12}$

Keithley - $1.2 \times 10 \times 10^{-12}$

11:25 Drain soln thru feed valve

Cont Exp # 147

11:53 Add Approx 84.0 ML of Conc. UO_2F_2 soln

start Circulation

liq level / tA / Refl Rod / temp

1:05 91.701 / 17.14 / 99.997

Source in - Inst Response IC - 1, 2, 3, 4

1:31 29.008 / 9.02 / 99.997 / Sub Critical

log N - 3.5×10^{-12}

Enriched log N - 9.5×10^{-12}

BeckMan - $1.4 \times 10 \times 10^{-12}$

Keithley - $1.3 \times 10 \times 10^{-12}$ / .99027

1:42 Drain soln thru feed valve

Cont # 147

2:13 Add Approx 119.0 ML of Conc UO_2F_2 soln

start Circulation

liq level / tA / Refl Rod / temp

91.703 / 17.14 / 00.000

3 23 Source in - Inst Response - IC - 1, 2, 3, 4,

3:50 29.012 / 9.46 / 00.000 / Sub Critical

log N - 4×10^{-12} / .9935

Enriched log N - 1.2×10^{-11}

BeckMan - $2 \times 10 \times 10^{-12}$

Keithley - $1.9 \times 10 \times 10^{-12}$

3:55 Drain soln thru feed Valve

12-9-58

8:20 AM Cont # 147 R.S. C.C.
Add Approx 96.25 ML of Conc UO_2F_2 Soln
start Circulation
liq level +A Refl Rod temp
91.696 17.14 00.000
9:37 Source in - Inst Response IC - 1, 2, 3, 4
10:09 29.021 8.82 00.000 Sub Critical
Enriched log N 1.5×10^{-11}
log N 6.5×10^{-12}
Beckman $3.3 \times 10 \times 10^{-12}$
Keithley $3.3 \times 10 \times 10^{-12}$ .98747
1 Min count Counter # 1 20 X 16 ~~1 Min Count~~
22 X 16 + 13
20 + 2
10:19 Drain Soln thru feed Value
Cont # 147 C.C. R.S.
10:30 Add Approx ~~60.5~~ 57.75 ML of Conc UO_2F_2 Soln
start Circulation
liq level +A Refl Rod temp
91.699 17.14 00.000 Sub Critical
12:00 Source in - Inst Response IC - 1, 2, 3, 4
12:29 29.197 10.52 00.000 .99152
Enriched log N 2.1×10^{-11}
log N 9.0×10^{-12}
Beckman $5.4 \times 10^{-1} \times 10^{-12}$
Keithley $5.4 \times 10 \times 10^{-12}$
1 Min count Counter # 1 (A) 29 X 16 + 14 (C) 32 + 3
(B) 31 X 16 + 9 (D) 33 See Next Page

12:40 (E) 33 + 13 (F) 32 + 5
Drain Soln thru feed Valve

Cont # 147 C.C. E.R.R.
1:15 Add Approx 70 ML of Conc UO_2F_2 Soln
start Circulation
liq level +A Refl Rod temp
91.701 17.14 00.000
2:21 Source in - Inst Response IC - 1, 2, 3, 4
3:06 29.005 9.62 00.000 .99429
Source out Slightly Super Crit
3:28 Remove Refl Rod Neg Period = -189 Sec
29.001 9.62 30.94 .99431
3:40 Drain Soln thru feed Value .99431

12-10-58 # 147A
Re-Run of # 147 R.S. C.C.

liq level +A Refl Rod temp
9:32 AM 91.697 17.14 00.001
Source in - Inst Response IC - 1, 2, 3, 4
False Alarm - Due to failure to Reset Panel
9:45 AM stopped for truck to ~~unload~~ Get in to Rm # 108
9.325 17.14 00.001
10:17 Resume Operation .98285
10:47 Source out Pos Period
26.096 00.07 00.001
10:51 Remove Refl Rod Slightly Super Crit (cont)

12-10-58

Cont # 147A

	lig level	+A	Refl Rod	temp	
10 58	29.025"	13.49	30.94	.98285	Super Crit
11 02	26.375"	0.07	30.94	.98282	slightly super Crit

Pos Period taken with lig level At 29.025" = 164.7 sec

11 45 Drain Soln thru feed Valve $\rho = 4.2 \times 10^{-4}$ $T = 20.5°$

12-10-58 Exp # 148 (U-235) R.S. C.C.

foil Exposure - U/235 foils

#3 Cd Covered 1" Below Center

#1 Bare 1" Above "

	lig level	+A	Refl Rod	temp
	91.703	17.14	99.998	

2 10 Source in - Inst Response IC-1, 2, 3, 4

2 55 28.475" 17.14 99.998 Pos Period

3 00 time foil Exposure Enriched $\log N$ 3×10^{-10}

3 10 Source out — Refl Rod Raised Approx level

28.477 17.14 3.57 .98483

3 21 Drain Soln thru feed Valve

ρ @ 20°C $\approx 5.0 \times 10^{-4}$

9 50 AM

10 31

10 34

10 45

10 47

10 51

10 54

12-11-58

Exp # ~~148~~ 148 (Gold) R.S. C.C.

Foil Exposure Gold foils

#49 Cd Covered 1" Below Center of Reactor

#48 Bare 1" Above Center " "

lig level	+A	Refl Rod	temp
91.699	17.14	99.996	

Source in - Inst Response IC-1, 2, 3, 4

27.368	14.36	99.996	Pos Period

start timing foil Exposure $\log N = 1.3 \times 10^{-9}$

Raised Refl Rod slightly Pos .9814

26.675"	11.51	30.94	Approx level
26.740	12.02	30.94	$\log N = 5.1 \times 10^{-9}$ level

Drain Soln thru feed Valve .9818

12-12-58

#150 Fission Counter Traverse D.W.M. C.C.

	Liq. level	Tad Addn	Reflector ~~Fission Cntr~~	Temp	
1:40	Start solution				
~~1:50~~					
2:12	29.042	7.92	0.01	98159	Rising on a period
	with				
2:20	29.042	7.92	.01	.98165	Rising on + Period
	29.042	7.92	30.93		Rising on + Period
	level by lowering solution, dumping some thru feed valve				
2:31	26.338	.31	30.95		Approx level
	Hi Level Gamma reads 13 μa				

Position	C_2	C_3	C_2	C_3	C_3/C_2

Run # 150

Counter Data

33	26.723	7.05	30.90	24

2:36

3:08

3:10 5 l/sec

3:14

3:15

3:24

3:31

#150 Counter Traverse (Cont)

	Level	Tad	Counter	Reflector Rod	Temp
	26.675	6.44	23.00	30.90	
3:40 PM	26.644	5.95	22.00	30.90	
	26.589	4.91	21.00	30.90	
47	26.558	4.41	~~20~~ 19.00	30.90	
49	26.531	3.89	18.00	30.90	.98299
53	26.525	3.89	17.00		
58	Shutdown, drain thru feed Valve				

12-15-58 Exp # 151 D.W.M. C.C.

37½% foil Exposure

#9 Cd Covered Mounted 1" Below center of Reactor

#8 Bare — " 1" Above " " "

liq level	+A	Ref Rod	temp
91.694	17.14	00004	

Source in - Inst Response IC-1, 2, 3, 4 with

29.025	9.59	00004	.99936	Pos Period source in

Start timing foil Exposure At $\log N = 3 \times 10^{-10}$

Remove Source And Refl Rod slightly Pos

26.431	0.07	30.94	.99964	Approx level
26.384	0.80	30.94		level

Shut Down - Drain soln thru feed Valve

Position (in)	C_2 x256	C_3 x256	C_2	C_3	C_3/C_2
46	343+247	9 + 163	88,055	2,467	.028016
45	344+246	11 + 249	88,310	3,065	.03470
44	342+179	17 + 217	87,641	4,569	.05213
43	336 + 58	90 + 60	86,074	23,100	.26837
42	329 + 204	184 + 136	84,428	47,240	.55953
41	320 +235	263 + 100	82,155	67,428	.82074
40	311 +249	330 + 18	79,835	84,498	1.0584
39	304 +246	393 +221	78,070	100,829	1.2915
38	298 + 75	452 +250	76,363	115,962	1.5185
37	290 + 47	504 +228	74,287	129,252	1.7399
36	282 +171	541 + 87	72,363	138,583	1.9151
35	256 + 56	534 + 192	65,592	136,896	2.0871
34	238 +202	532 +107	61,130	136,299	2.2296
33	235 +231	544 + 37	60,391	139,301	2.3066
32	228 + 80	546 +122	58,448	139,898	2.393554
31	224 +247	547 + 101	57,591	140,082	2.4323
30	223 + 38	541 +212	57,126	138,708	2.4281
29	225 +170	536 + 79	57,770	137,295	2.3766
28	227 + 90	523 + 85	58,202	133,723	2.3018
27	236 + 50	517 +111	60,466	132,463	2.1907
26	241 +254	491 +128	61,950	125,824	2.0310
25	243 +199	456 +204	62,407	116,940	1.8738
24	247 +218	415 +168	63,450	106,408	1.6770
23	250 +185	363 +254	64,185	93,182	1.45177
22	256 + 39	315 +182	65,575	80,822	1.2325
21	257 +224	257 +243	66,016	66,035	1.0003
20	259 +166	199 +139	66,470	51,083	.7685
19	260 +162	147 +224	66,722	37,856	.5674
18	262 + 74	81 +139	67,146	20,875	.3109
17	260 +169	37 +164	66,729	9,636	.1444
16					

37% Accounting

Final wt. of solution in cylinder

Gross 7.20 kg
Tare 2.71 kg
4.49 kg solution returned

26.56
4.49
22.07 kg solution used
× .44959 gm/gm
9.92₂ kg U used

After using and diluting

1	A	30.48	2.16	28.32
2	B	30.04	2.20	27.84
3	C	29.92	2.89	27.03
4	D	30.03	2.28	27.75
5	E	29.85	2.60	27.25
6	F	29.89	2.15	27.74
7	G	29.71	2.38	27.33

193.26
8.43
201.69 × 48.8 = 9.84

#13

Rinsings

27.40 2.14 25.26
24.65 2.30 22.35
47.61

∴ we have ~80 gms in samples rinsings and losses.

Est samples ~ 70 ml × 4 = 280
× 1.057 = 296 gms of sol'n
× 48.8 = 14g

Est content of rinsings ~.3 mg/gm
47.61 × .3 = 14 g

∴ ~50 gms losses. However analyses are not this good.

12-17-58
D W Magnuson

Info Entered in this Book 3-25-64

"Note" Analysis for 37% Soln used in 27" Sphere
49.15 mg/g
1.0574 g/cc
51.97 g/l
wt % U/235 - 37%

25 l Bottles No 1, 2, 3, 4, 5, 6, And 7 stored in Vault

4" Sphere Calibration

Sphere fill	Tare	Net H_2O		
to top of flange.	Zeroed with beam	100 kg		
	"	102 kg		
	"	100		
Bottle $\frac{1}{2}$ 3 (up)		100	kg	14.5°C
10 p 13		100		14.5°C
2 Will $\frac{5}{8}$		100	kg	14.5°C
$10.39 \times \pi \times .125 \times .7854 \times 9 = 2.3$ l		100	kg	14.5
		100	kg	14.5
		100	kg	14.5
		48.6		
		950.6 kg		

.99920 gms/ML H_2O density @ 14.5°C

Total Volume = 951.4 liters

$\frac{950.6}{.99920} = 951.4 \times 10^3 \text{ Cm}^3$

~~$\frac{2.3}{949.1}$ l~~

~~Effective radius = 61.01 cm or 24.02"~~

$\frac{4\pi}{3} r^3 = 949.1$ 121.99

$r^3 = \frac{949.1}{\pi} \times \frac{3}{4} = 226.58$

$r = 60.97$ cm

12-24-58

Overnight leak Test on sphere OK

After assembly several hour leak Test on all flanged joints showed noleaks. sphere full @ 30 on liq. level.

Without istension counter probe at 994.00 for counter at mid plane — reset to 000.00

Added 4 barrels of H_2O → 19.30

	liq level	
12	32	19.30
	39	6.95
	40	9.90
	44½	14.519 Pump lost prime.

Reset zero on Manometer so that 48.0 corresponds to Top of sphere and 60.3 at bottom of flange

33.775

48.0
33.78
14.22 × 2.54 = 36.12 cm

empty volume = $\frac{\pi}{3} \times 36.12^2 (3 \times 61.01 - 36.12)$

183.03
36.12
146.91

$1.047_2 \times 1304.65$
791 666.

= 200.7 liters

∴ Volume added is 751.4 + liters h_2O

Date | Conditions or description
time | liq level | Uranium content

Source M-226 inserted to midplane with #3 min.

12-24 | 2^30 PM | EXP #152 PURE H_2O Background Counts.

2^55 PM | 33.796
+1
21.167 | Drain H_2O

Keith Beck, log

12-26 | 8^35 AM | 21.059 | Filled system. | .2×3×10^-12 | .16×3×10^-12 | 5.5×10^-13 | 1.2×10^-12
33.7 — | | .04×3×10^-12 | .05×2×10^-12 | 1.3×10^-13 | 4.3×10^-12
9^05 AM | 33.779 | " | " | " | "

EXP #153 Added 1 bottle of UO_2NO_3 #91 2.499
+15 l from 25 l bottle + ~10 l from 15 l bottle ~.35 2.85 kg

10 | 10^20 | 22.062 | .2×3×10^-12 | .17×3×10^-12 | 5.5×10^-13 | 1.2×10^-12

EXP #154

11^40 | 22.852 | Add Bottles #90 & 92 4.676 kg Total 7.53 kg T

conc ~ 10 g/L

12^00 | 30.856 | .28×3×10^-12 | .22×3×10^-12 | 1.3×10^-12 | 2.3×10^-12
12^12 | 32.081 | ~~1.7~~ 2.0×10^-12 | ~~2.0~~ 1.7×10^-12 | 3.5×10^-12 | 6.5×10^-12
12^20 | 32.735 | 4.1 | 3.2 | 7.0× | 1.3×10^-11
12^33 | 33.049 | 6.6×10^-12 | 5.0×10^-12 | 1.15×10^-11 | 2.1×10^-11
12^45 | 32.724 | Drain back | 3.5 | 2.75 | 6.0×10^-12 | 1.1
12^51 | 31.898 | .46×3×10^-12 | .34×3×10^-12 | 2.2×10^-12 | 4.0×10^-12
30.842 | .20×3×10^-12 | .17×3×10^-12 | 9×10^-13 | 1.8

Dump solution @ 28.296

fission counter, Channel #1 and #2 are BF_3 counters

	C_1	C_2	C_3
5'	X	532×16+11	114×16+0 (30)
5'	X	518×16+11	155×16+4 (15)
5'	12×16+1	538×16+4	136×16+9 (20)
5'	13×16+15	552×16+4	121×16+6 (25)
5'	14×16+5	594×16+8	94×16+2 (40)
5'	13×16+6	496×16+4	114×16+2 (30)
5'	59×16+10	807×16+2	0×16+13 (30)
5'	68×16+12	520×16+2	1×16+5 (30)
5'	13×16+11	179×16+4	113×16+12
5'	14+4	170+10	113+9
~~5'~~ 5'	61×16+10	513×16+3	1×16+8
5'	62+1	529+14	2×16+4
5'	71+8	1327+14	116×16+10
5'	172+7	863×64+52	118+0
5'	357^16+8	435×256+97	118^16+9
5'	548+8	688^256+58	121^16+1

Checked Inst and turned on Corridor light

Lig. Level — EXP #155 — ADC Dwn DEM

		K	B	N log N	E log N
1 35 PM	Start Pumping – Same solution repeated #154.				
1 45	30.852	×0.5 ×10⁻¹²	×0.7 ×10⁻¹²	1 ×10⁻¹²	2.2 ×10⁻¹²
1 56	32.027	×1.3 ×10⁻¹²	×1.3 ×10⁻¹²	2.3 ×10⁻¹²	4.8
2 05	32.769	×2.6	×2.2	4.2	8.5
2 15	33.296	×4.8	×3.6	7.5	15.0
2 23	33.634	×7.8	×5.7	12.0	24.0

Dump to 33.04

#156 Start pumping again — ADC Dwn DEM

2 33	33.042				
	33.6			8.0 ×10⁻¹²	16.0
2 53	34.727	×3.9 ×10⁻¹¹	2.9 ×10⁻¹¹	5.0 ×10⁻¹¹	10.5 ×10⁻¹¹
3 06	34.950	Instruments rising not on a		+ period. Linear inst v straight line ∴ near crit.	
3 06		Dump	Take sample 354978	from tank with 100 ml pipette.	

#157 Repeat #156. Dwn DEM

3 48	Start Pumping				
	33.0				
4 00	33.6	3.6 ×10⁻¹²	3.0 ×10⁻¹²	6.0 ×10⁻¹²	1 ×2. ×10⁻¹²
	35,588	Rising	close to Critical		
4 10		Dump			

10 00 — 12 – 29

	C_1	C_2	C_3
	63 x16 +14	302 x64 + 0	115 x16 + 14
	132 +8	647 +28	121 +1
	233 +12	1149 +25	116 +1.3
	907 +2	1999 +8	121 +4
	646 +11	801 x256 +111	120 + 5
	180 x256 +103	Damned	150 x16 + 12
	60 +10	604 +13	2 +1 (x16)

12-29-58

Analysis of #354978 → 18.15 mg/g d=1.0258 = 18.62 mg/ml

Measured height of solution in tank ~ 47"

or a volume of 363 l

∴ Total mass of U in Tank is 6.76 kg

Since there is an estimated 7.5 kg in the entire system ∴ 0.75 kg are in sphere

and this means from a volume of Vol = $\frac{\pi}{3}$ 58.4²(181.03 − 58.4) = 1.0472 × 3,410.6 × 122.63 = 438 l

$\frac{0.74\ kg}{438}$ = 1.69 g/l this is an impossible situation !

Specific gravity measurements

Drained	~ 1 l	thru pump from Tank	Sp Grav	1.030	22.0 mg/ml
"	~ 8 l	thru feed valve from Sphere	Sp Grav	1.029	→ 21.2 mg/ml
"	~ 6 l	" " " " "	Sp "	1.0285	→ 20.8 mg/ml

In sphere 438 l × 20.8 g/l = 9.11

363 × 22.0 g/l = 2.99

17.10 kg U

12-29-58 Exp # 158 Repeat 157 Dwgs 4D C-

	Liq. Level	K	B	N on N	En h N	C_1	C_2	C_3
	32.55	.7 ×10⁻¹²	.65×10⁻¹²	5.5×10⁻¹³	1.4×10⁻¹²	? ×16+	×256+	×16+
12 57 PM	30.885	.75	.7	1.1 ×10⁻¹²	2.5 ×10⁻¹²			
1 03 PM	32.005	1.2	1.1	2.0	9.3			
1 07 PM	32.740	1.8	1.6	3.1	6.7			
1 11	33.243	2.5	2.1	4.2	9.0			
1 13	33.647	3.4	2.7	5.5	12.0			
1 22	34.395	6.0	4.9	10.3	22			
1 24	34.741	.29 ×30	.24×30	15	32	284 +8	363 +151	123 +14
	35.288	.56	.46	28	62			

	Liq level	K	B	N log N	E N log N
135	35.595	3.1×10^{-11}	2.7×10^{-11}	5×10^{-11}	11×10^{-11}
38	35.725	4.3	3.6	7	16
42	35.906	.30 x30	.26 x30	14	32

Dump solution thru 3" Dump Valve

#159 Repeat #158

147	22.634				
201	33.659			5.2×10^{-12}	11.0×10^{-12}
206	35.752	1.6×10^{-11}	1.5×10^{-11}	2.7×10^{-11}	6.0×10^{-11}
209	35.925	2.0	1.8	3.6	7.5 $\times 10^{-11}$
	Tank empty.				
	36.136	3.0	2.6	4.8	10.5

Dump solution thru 3" Dump Valve

#160 Repeat #159

215	24.7				
21	30.6				
27	36.106	1.5×10^{-11}	1.3×10^{-11}	2.4×10^{-11}	5.5×10^{-11}

Dump

#161 Repeat 160

232	22.603	$.32 \times 3.0 \times 10^{-11}$	$.27 \times 3 \times 10^{-11}$	1.5×10^{-11}	3.4×10^{-11}
249	36.088				

Dump

~~22.59~~ #162

252	22.59				
306	36.042	.24	.21	1.15	2.5×10^{-11}
	22.601	Dump			

drifting up scale not level
" " " " "

lost reactn from #158,

Temp .99755 lost react from #159

#163 DWM DBM & C

Fill sphere with recirculating line

3 28 22.7
29 22.780
30 22.988 } .776 "/5' = .155 "/MIN
31 23.138
32 23.275
34 23.556

Increase recirc rate

23.751
36 30 Pump on
38 30 24.17 } 1.07 "/4' or 0.27 "/MIN
39 24.42
42 25.24 > .80/3 or 0.27 "/MIN
45 26.04 > 1.05/4 or 0.26 "/MIN
49 27.09 > 1.04 or 0.26 "/MIN
53 28.13
57 29.17 No Mult. $4.X10^{-13}$ $9x10^{-13}$
4 01 30.21 " " "
04 31.02 Stop adding. Should be some multiplication

To be safe — dump slowly thru feed valve

4 07 30.44
4 10 29.50
13 28.46
Dump
22.94

Increase circ rate

4 25 Start recirculation

26 30 23.253
27 30 .504
29 28 30 .904 } 1.16/4' = 0.29 "/MIN
30 30 24.41

open dump

32 22.878 open recirculating valve.

38 23.175 > .32
39 .49 > .33
40 .82 dump

open recirc valve. wide open.

4 58 Stop circ!

44 → 23.365 = .43
46 24.11 } 2.17/5
48 49 25.525
52 26.916 > 1.391/3 = .448

with 2 ft 1/2 S.S. tube on end inserted into top 3" port. N.B. Feed starts when pump comes on

For height of 36 +" empty volume

$V = \frac{\pi}{3} 30^2 (183 - 30)$

$1.047 \times 900 \times 153 = 144$ l

$\frac{3.551}{8}$ = .444 "/min $\pi R^2 x l = 1809.6 \times 16.39 = 29.65$ l/in or 13.16 l/min.

#164 Dwn AdC

458 Start filling sphere with both fed valves and recirculating line.

59 24.55

501 26.86
03 29.12
05 31.09 ~~Not~~ More mult than when recirc valve only filled to this level.
08 34.00
0930 35.823 Essentially no multiplication

12-30-58

The conclusion from the preceding is that the system was very poorly mixed when sampled and the present lack of multiplication is consistent with the amount of uranium thought to be in the three bottles.

Add ~ 100 ℓ H_2O + ~~2.1 kg uranium + 15 ℓ~~ ~~previously drained from system~~ ($\delta \cong 1.030$ wtd)

130 ℓ H_2O added with dump valve open!

Man before 23.176
" after ~~24.934~~ 25.006

Instruments were checked for trip's only.

Dwn DE McP

940 Start add $UO_2(NO_3)_2$, half of bottle # 1
Reg No 166 368 or ~ 2.1 kg of U and 1 ℓ.

1100 end of filling period

EXP #165 Dwn DEM

1110 Start filling sphere

		NenN	EN enN
	25.024	$.6 \times 10^{-12}$	1.4×15^{-12}
14	31.1	.7	1.6
20	36.153	1.1	2.4
24	40.1	1.5	3.0

(60) (200) (120)

	C_1	C_2	C_3	$\frac{1}{C_1}$	$\frac{1}{C_2}$	$\frac{1}{C_3}$
→	77 X16+15	368 X64 +50	155 X16 +9	.013 ~~.018~~	.0027 .54	.006 .65

12-30-58 #165 (Cont

	level	N log N	E ln N	C_1	C_2	C_3	$\frac{1}{M_1}$	$\frac{1}{M_2}$	$\frac{1}{M_3}$
11 34	41.649	1.4×10^{-12}	3.2×10^{-12}	87 x16 +2	392 x64 +47	165 x16 +6	.0115	.00255	.00606

h = 6.35" = 16.13 cm 183.03 − 16.13 = 166.9

$V = 1.047_2 \times 260.18 \times 166.9 = 45.5\ell$

Total Mass = 7.53 + 2.11 = 9.64

dump to 25.580

---

11 48 With dump valve open start circulation in to sphere

11 51 Stop Circ.

11 53 Restart Circ.

1233 Start EXP #166 feeding thru fast feed and recirculating line to sphere!

	25.575	$.8\times10^{-12}$	1.8×10^{-12}						
12 36	28.7	.8	1.9						
40	32.4	.8+	1.9+						
43	36.18	.85	1.9						
49	40.1	.8	1.85	53 +15	234 +3	160+15			
56	41.58	.8	1.85	50 +11	282+21	164+13			

Dump solution To 25.588 (58)

With dump Valve closed and recirculation going To tank − add 2.11 kg Total = 11.75

1 00 PM − 2 30 Added 2.11 kg very slowly.

EXP #167 Down DEM

2 34	25.591	.9 x10⁻¹²	1.9	Recirc valves closed!	
37	28.47	1.1	2.4	Multiplication !	
41	38.69	2.2	4.4		"
44	33.69	2.6	5.5		"
48	36.18	3.8	7.5		"

EXP # 167 (cont)

	level	N ln N	E N ln N	C_1	C_2	C_3			
2 51 PM	38.98	5.2×10^{-2}	11.0×10^{-12}	x16	x256	x16			
55 PM	41.884	7.5	16	382+11	452+253	210+	.131	.128	.781

3 02 Dump solution to 26.003 (21' to fill)

Start Circulation thru sphere.

3 07	26.002	.95	2.0
17	25.985	1.1	2.6
27	25.984	1.2	2.8
38	25.985	1.4	3.0

Start filling for EXP # 168 with circ and feed valves. Close ampules.

EXP # 168 Down DEMcC

PM

3:38	25.985								
45	39.02	2.5	5.5						
50	41.79	2.8	6.0	(12' to fill)			.296	.309	$\frac{1}{M_3}$
	Stop Filling							.3495	
56				156+1	166+227	203+4	.321	1.398 / 4	.808

Dump thru 3' valve

EXP # 169 Repeat 168

Fill thru recirc valve & feed valve

4 00	25.668	1.55	3.4						
4 12	41.7	2.6	6.0	160+7	168+53	214+6	.312	.345	.766
4 18	Dump thru ~~Feed~~ 3" valve.								

$\frac{1}{67^2}$

25.672

12-31-58

8 05 Start circulating thru sphere

	25.734	1.6×10^{-12}	3.5×10^{-12}						
25	.725	1.6	3.5						
36	.727	1.6	3.5						
40	Start filling EXP #170 (Repeat 169 after 35' Mixing)								
				C_1	C_2	C_3			
5 21/2	41.7	2.7	6.5	165+12	164+32	209+3	.303	.358	.820

Temp .99675 Spin is full enough to wet thermistor!

Dump solution

	Level	N/n N	EN/n N	C_1 x16	C_2 x256	C_3	$\frac{1}{M_1}$	$\frac{1}{M_2}$	$\frac{1}{M_3}$
9[17]	25.680	1.5×10^{-12}	3.5×10^{-12}	106 ±10	92 ±27	14±5	.472	.63	—

~~Dump solution~~ Above counts with solution dumped

January 2, 1959 Dr Wm R.G.
Added about .57 kg in ~ 1 hour.
Total now 12.32 kg U
Checked trippes on Keithley Beck man & RM.
Checked ln N's for response.

EXP # 171

	Level	N/n N	EN/n N	C_1 x16	C_2 x256	C_3 x16	$\frac{1}{M_1}$	$\frac{1}{M_2}$	$\frac{1}{M_3}$
3[25]	25.85	1.7×10^{-12}	3.3×10^{-12}						
30	30.30	2.7×10^{-12}	5.5×10^{-12}						
40	36.85	4.2×10^{-12}	9.0×10^{-12}						
50	42.0	5.5×10^{-12}	11×10^{-12}						
				296 ±15	316 ±34	239 ±2	.169	.184	.686

Dump thru 3" valve.

4[02] 25.79 Start mixing by circ thru sphere.
4[32] 25.79 Stop " " " " "

EXP # 172 Jan 5, 1959 Dr Wm C.C.

Checked Instrument Trips.

8[40]	25.77	1.8×10^{-12}	4.0×10^{-12}						
48	30.21	3.0×10^{-12}	6.2×10^{-12}						
55	36.71	4.0×10^{-12}	8.2×10^{-12}						
9[01]	41.96	4.5	9.0	240	251	239	.192	.231	.686
		.178	.206						

Dump Reflector Rod 20" OD x 8" paraffin
47.0 → 7.78 No change in instruments!

Add slowly 0.57 kg to slab Tank
Total U = 12.89 kg

EXP # 173 Jan 5, 1959 Dr Wm C. e

	Level	N/n N	EN/n N	Rod	C_1 x16	C_2 x256	C_3 x16			
131	25.824	2.0×10^{-12}	4.0×10^{-12}	7.78						
38	30.28	4.0×10^{-12}	9.5×10^{-12}	7.78						
45	36.80	7.3×10^{-12}	1.5×10^{-11}							
51	42.20	$11.\times10^{-12}$	2.2×10^{-11}	7.78	621	641	294	.0805	.0905	.558
				↓						
156		no change		27.99						

Dump solution thru 3" valve

EXP # 174 Jan 5, 1959 Dr Wm C. e

2[00]PM Start Circ thru sphere Dump valve open
25.895
2[30] 25.894 ~~Start~~ Pumping thru circ and feed.
2[30] 2.5×10^{-12} 5.0×10^{-12}
236 30.21 4.7 9.
245 36.84 7.0 13.5
50 42.18 7.8 16.0 27.99

Temp = .994/31

C_1 x16	C_2 x256	C_3 x16			
471	475	286	.106	.122	.573

No change. 7.79

3[00] Dump solution thru 3" dump valve.

Jan 6, 1959 8[15] AM
Clock Reading of Operating Time 7/6 hrs

Febr 16, 1960
Clock Reading 1033

Jan 6, 1959

added 30 l H_2O on Jan 5 3^{30} – 4^{30}.

level reads ~~26.186~~ 26.670

$\frac{12.84 kg}{910 l} = 14.3$ g/l

From ~~multiplication curve~~, it is estimated that 500 - 600 g can be added

14.3
30
429 g
600
1029 g can be added

Will add half of container #101 or 900 g.

EXP #175 Jan 6, 1959 — Dump c.c.

Total U = 13.79 kg.

10^{15}	Dust Trips checked OK.				
10^{24}	Level	N&N	EN&N	Rod	
	26.855	3.2×10^{-12}	6.7×10^{-12}	7.79	
22	Start filling sphere. normal feed valve.				
25	Stop				
27	30.31	5.8	12.		
27	Start filling				
30	Stop "				
32	33.64	9.5	20.	7.79	
32	Start filling				
34^{40}	Stop "				
36	36.86	15.	32	7.79	
36	Start Filling				
38^{30}	Stop "				

Someone opened corridor door, Janitor bumped door

40	39.7	23	48	7.79

There seems to be some oscillation of power level perhaps due to circulation of lumps of enriched solution. Hence will wait a few minutes to watch this.

45	start filling			
46^{45}	Stop			
48	42.26	32	69	
49	Start filling slow feed.			

	Level	N&N	EN&N	Rod	
58^{30}	Stop filling Tank empty Temp 99.545 =				
11^{00}	45.15	44.8×10^{-12}	9.5×10^{-12}	7.79 ↓	
	No change on dust		22.18	counter rod up	3"
		C_1 x64	C_2 x256	C_3 x16	3" x 2.54 = 7.5 cm
11^{06}	45.16	602+24	2480+43	603+1	Empty Vol = $1.047_2 \times 7.5^2 (183 - 7.5)$
		.0203	.0234	.272	= 58.91 × 175.5 = 10.3 l
11^{08}	Dump solution				

11^{10}	26.88	
11^{13}	Start	Circulation into sphere. Tank
11^{30}	Stop	" into Tank
11^{31}	Start	Circ from Tank into sphere.
12^{01}	Stop	Circ from Tank into Sphere

EXP #176 Jan 6, 1959 Dump c.c

fill thru feed valve and circ line

					C_1 x64	C_2 x256	C_3 x16
12^{01}	26.89	Start filling					
12^{15}	45.10	Stop filling					
12^{20}	45.1	2.3×10^{-12}	5.5×10^{-12}	22.18	355+48	1389+43	488 + 9
		2.4	5.7×10^{-12}	M^{-1}	.0351	.0418	.335

Dump solution Temp 99.425

Remove large source from center of 4' sphere.

12^{40} Insert small source to equatorial plane outside sphere

Background count	N&N	EN&N	C_1 x64	C_2 x256	C_3 x16
level = 26.88	3.9×10^{-13}	8×10^{-13}	17+0	16+95	0+0

EXP #177

Repeat #176 using small source for start up or multiplication measurement

12 46½ Start filling

Level		NM	NO	EN	Rod
26.88		$.36\times10^{-12}$	$.75\times10^{-12}$		22.19
12 57 45.03		$.40\times10^{-12}$	$.90\times10^{-12}$		22.19

Very little Multiplication shown on instruments. Temp .99385

	C_1 ×16	C_2 ×256	C_3 ×16
	20+7	20+188	3+11
	20.44	20.73	3.69

1 05 Remove source sphere full

45.11 $.23\times10^{-12}$ $.45\times10^{-12}$

1 07 Dump solution.

Add 300 g of solution bottle #101 - 14.09 kg

2 06 Start mixing thru sphere with dump valve open

2 13 Stop mixing EXP #178 DWM C.C

2 14 Start mixing — vibration of recirc stream making fission counter give spurious counts.

2 37 ~~Stop~~ mixing
Start filling with fast feed and circ flow.

2 37	26.95	$.28\times10^{-12}$	$.70\times10^{-12}$	22.19
38	28.17			

Pump off To get stable for cylinders.

3 9½ Pump off. 9950,

5 5 41.26 .75 1.7 22.19

C_1 ×16	C_2 ×256	C_3
49+14	47+116	13.+6
.88	.45	
.410	.437	.264

0 6 45.33 .85 2.0×10^{-12}

EXP #178 (Cont

Insert Reflector Rod - No change of mult. shown on instruments

Remove source decays pretty fast.

Insert source. Shows some effect of delayed neutrons.

Dump solution.

EXP #179 Repeat #178

3' 27 99	27.00	$.28\times10^{-12}$	$.70\times10^{-12}$	7.79 ↓	
42	45.26	.7	1.7	22.2.	

Sphere nearly full Temp .99515

45 45.32 .7 1.8[illegible] 22.20

C_1 ×16	C_2 ×256	C_3 ×16
48+0	45+246	14+11
48	45.96	14.69
.425	.451	.251

Total 14.39

Add approx 250-300 g of U and 9 l H_2O

5 00	Start Mixing thru Tank Recirc.	}	~~27.18~~
5 15	Stop Mixing		
5 17	Start Mixing by circ thru Sphere	}	27.19
5 47	Stop " " " " "		

~~5 47 Start~~ EXP #180 DWM C.C.

5 47 Start filling sphere with ~~Fast Feed~~ and circ line.

5 58 Stop " " " " " " " "

6 00	42.15	$.80\times10^{-12}$	1.9×10^{-12}	7.79
6 04	46.53			

Tank empty power rising Temp .99614 = 24.00°C

6 05 Remove source slightly negative period

Insert source to raise power

6 12 Remove Source

6 14 46.54 1.4×10^{-11} 3.5×10^{-11} System is critical Δk < 10^{-4} Dump Solution 27.18

Jan 7, 1959

Height reading on manometer in error due to diff density solution in manometer

Add 10 l H_2O + 200 g U. dump closed

923 AM Start recirculation mixing in tank
938 Stop " " " "
942 Start recirc mix thru sphere dump open
1013 Stop " " " " "

Total 14.59 kg U.

Checked Dust Trips. EXP # 181 Dwn C.C.

	Level	NLN	Beck Counter (Control)	Rod	Counter (NJO Plane)	Temp
1016	27.618	$.3 \times 10^{-12}$	$.4 \times 10^{-12}$	7.79	00.00	
26	40.9					
32	46.9	10×10^{-12}				

Overflow into sphere acts as a syphon dump solution

1034 Start feeding fast & slow

35 29.2 $.3 \times 10^{-12}$

1055 On positive period source out rod out 124.3 cm 5.30×10^{-4}

53.277 — — 38.90 00.00 .99364 T = 23.24

1100 Level by draining solution from sphere.

1112 46.79 10^{-9} 5.6×10^{-10} 38.90 00.00 .99394

1119 Insert Reflector Rod + Period #2

1124 Dump Solution

1129 2610 read 20 MR top of ladder

1130 Start circ. thru Sphere. for more mixing Inserted source.

117 Stop Circ.

Moved ENLN behind shadow shield of 4" of lead but it is now closer to the sphere 30" instead of 40"

1-7-59 EXP # 182 Repeat # 181 after thorough mixing 1 hr 47'. Dwn. C.C. Source Dr.

		NLN	ENLN	Rod	Counter	Temp	
122	27.62	8.8×10^{-12}	$.55 \times 10^{-12}$	7.79 ↓	00.00		
126	32.05	.85	.60	47.00	00.00		
130	36.64	.80	.75				
142	Sphere full source out, on + period						$\rho = 5.06 \times 10^{-4}$
142	54.034	Rising		47.00	00.00	.9947	T = 23.62
145	Start TO level by draining solution.						
153	46.87	10^{-10} approx		level		1.8×10^{-10}	

Lower power by factor of 10 so that reflector rod can be calibrated

155 45.10 Neg Period #2

208 46.97 Nearly level $.82 \times 10^{-11}$ 1.3×10^{-11}

210 46.97 .87 1.4 .99477 Slightly Super

212 46.96 .9 1.5 Level

Remove counter ↓ 12.01 #3

Slight Positive Period — relevel with solution Lt

214 46.74 level — Insert reflector rod

218 46.74 + Period #4 7.79 12.01 .99482 $\rho = 1.60 \times 10^{-4}$

223 Remove reflector rod to level

---

250 Start Circulation

359 Stop Circulation

Jan 7, 1959

Instead 18" extension on fission probe counter
∴ 00.00 ~ 18" above mid plane
36.94" counter up limit ~ 7" from top
Sphere down limit = 995.66
Change selsyn down limit = 00.00
∴ up limit will be ≈ 40.28
up limit was 41.29

Exp # 183 DWM CC -
Repeat 182 after mixing for 1 hr 9'
Counters in place

NLnN	ENLnN	level	
$.9 \times 10^{-10}$	1.4×10^{-10}	47.21	.99548

Approx level for 2' count

C_2	C_3 @18"
175 x 16	395 x 16

Increase Temp setting on controller 4°F

Jan 8, 1959
Drained line to level manometer, hence it should give accurate height readings now,

Exp # 184 1-8-59 D.W.M. C.C.
Miniature Fission Counter Traverse
$.9 \times 10^{-10}$ → 175 x 16 / 2 min = 2800 counts / 2 min
$.9 \times 10^{-11}$ → 28000 counts / 2 min
10^{00} Level at NLnN = $X \times 10^{-9}$ for counting data
Pos Period 6.06×10^{-4}
level Rod Fission Counter T = 24.34
Rod down

10^{04}	45.704	7.78	00.00		
10^{17}	45.704	7.78	5.00		6.06
10^{33}	45.704	7.78	10.00		1.60
10^{48}	45.703	7.78	15.00		4.46
11^{00}	45.703	7.78	20.00		∴ @ 24.34
11^{30}	45.703	7.78	30.00		S ~ 4.80
11^{59}	45.703	7.78	40.00	temp	4.46
12^{05}	45.703	7.78	41.00	.99746	0.34×10^{-4} width of counters
12^{07}	Dump	Sol'N			

Counter data when plotted showed considerable scatter, implying bad counters at times or extra pulses on C_3

Samples #77 and #78 taken from slab tank with 100 ml pipette.

NAME OF NUMBER	NUMBER	EXPONENTIAL FORM
[redacted]		
Decillion		
Undecillion		
Duodecillion		
Tredecillion		
Quattuordecillion		
Quindecillion		
Sexdecillion		
Septendecillion		
Octodecillion		
Novemdecillion		
Vigintillion		
Centillion		
Novemvigintillion		
Novemtrigintillion		
Novemquadragintillion		
Novemquinquagintillion		
Novemsexagintillion		
Novemseptuagintillion		
Novemoctogintillion		
Novemnonagintillion		
Nongentillion		
Novemnongentillion		
Millinillion		

NAME OF NUMBER	NUMBER	EXPONENTIAL FORM	SYMBOL	PREFIX
Quintillion	1,000,000,000,000,000,000	10^{18}	Tq	
Quadrillion	1,000,000,000,000,000	10^{15}	Pq	
Trillion	1,000,000,000,000	10^{12}	T	Tera
Billion	1,000,000,000	10^{9}	G	Giga
Million	1,000,000	10^{6}	M	Mega
Thousand	1,000	10^{3}	k	Kilo
Hundred	100	10^{2}	h	Hecto
Ten	10	10^{1}	da	Deka
One	1	10^{0}		
Tenth	0.1	10^{-1}	d	Deci
Hundredth	0.01	10^{-2}	c	Centi
Thousandth	0.001	10^{-3}	m	Milli
Millionth	0.000001	10^{-6}	μ	Micro
Billionth	0.000000001	10^{-9}	n	Nano
Trillionth	0.000000000001	10^{-12}	p	Pico
Quadrillionth	0.000000000000001	10^{-15}	f	Femto
Quintillionth	0.000000000000000001	10^{-18}	a	Atto

Critical run to provide neutrons for Rohrer in counter check.

1-9-59 EXP # 185 Dwn RG

level Rod Counter Temp.

10 21 Start feeding solution, source in. Shut trips checked 27.

25 30.9 7.78 24.00 1.0049

Sphere full source out

40 53.68 7.78 24.00 1.00095 #1 ρ = 4.75

47.00 T = 25.24 #2 ρ = 3.05

level for count on fission counters

46.48 47.00 24.00 N/n N = 2.4×10^{-10}

C_2 = 12 x 64 + 0 Disc @ 9 C_3 = 247 x 64 + 11 Disc @ 30

10 55 Dump solution 26.985"

1-9-59

EXP # 186 Check Fission Counters. Dwn C.e

1 49 PM Start Solution, source in

55 33.6 7.79 24.00

2 00 39.5 7.79 24.00

2 06 Critical + period source out, Rod in #1

2 09 54.27 7.79 24.00 .9994 Pos Period #1

Withdraw Rod

2 13 54.28 44.78 24.00 Pos Per #2

2 15 Start to Level

2 19 46.44 44.78 .9995 Nearly level

2 22 Dump Solution

2 25 26.99

1-9-59 EXP # 187 Check Fission counters

(cables switched at counter)

2 28 start adding solution

level Rod Counter N/n N

2 40 89.0 44.78 24.00

2 44 53.44

49 39.6 44.78 24.00 $.8 \times 10^{-12}$

Dump solution after Rohrer convinced that the counter is N.G.

Replaced counter 5-3 with 5-1. -

3 22 27.0 EXP # 188 Dwn C.e. ERR

35 42.5

40 On + Period Source out sphere full

41 54.05 7.78 24.00 Rising to $.56 \times 10^{-9}$ on N/n N

51 46.62 37.16 approx level

55 46.48 37.16 24.00 level

C_3 = 622 x 64 in 2' N/n N = $.58 \times 10^{-9}$ E/n N = 1.1×10^{-9}

3 56 Dump solution

Counter 5-1 developed a leak and solution shorted counter. It was disassembled and cleaned. ERR will reassemble 5-1 as well as check out 5-3 for future use.

Exp # 189 Dow CC. 1-12-59

Bare and Cd Covered U-235 foils for λ determination in 4' sphere. Suspend foils on string on control rod so that excess react of 4' sphere can be determined unperturbed by counters or foils.

Inst. trips were checked OK

	Level	Rod	Probe	Temp	
			0 = Foils at center		
12 28	26.92	37.16	40.01		
29	Start pumping solution. Source dr, ~~Trips~~ Scrams Set.				
33	31.25	37.16	40.01		
53	53.88	37.16	40.01	1.00710 = 26.82 Source Out, on Pos Period	
	On Positive period to raise power to 2.7×10^{-10}				
56				1.007105 = 26.81°C	
56	Start foil in, dump solution @ 46.2				
~~58 15~~	58 30	16.5			
59 30	↓		00.0	Start timing exposure	
	46.38			N ln N = 3×10^{-10}	
				EN ln N = 5.7×10^{-10}	
104	46.37		00.0	1.00687 = 26.76	
115	46.37	37.16	00.0	1.00699 = 26.80	
119	46.37	37.16	00.0	1.00687	

End of foil exposure Dump solution

#3 Cd Covered 1" below center

#2 Bare 1" above center

1-12-59 Exp # 190 Dow ERR

	Level	Rod	Fission	Temp	N ln N
12 34	Start Adding Solution				
35	28.00	37.16	4.00		
45	40.00	↓ 7.28	4.00		$.8\times5^{12}$
49	47.5				
50½	54.236	Sphere full, remove source. (2×10^{11} on ln N)			
53	54.26	7.78	4.00		
	Power leveled at 7×10^{-10}				
304	Start counting on traverse at				
05	46.27	15.23	4.00	1.00283	7×10^{-10}
14	46.26	15.23	7.00		6.6×10^{-10}
35	46.26	15.23	16.00	1.00310	4.8×10^{-10}
37	46.26	↓ 10.34	17.00	1.00310	4.5×10^{-10}
39	46.26	↓ 11.01	18.00		
40	"	"	22.00	1.0032	5.0×10^{-10}
65	"	"	28.00		5.7×10^{-10}
12	46.26	15.33	31.00		6.4×10^{-10}
20	46.26	15.33	34.00	1.0033	6.1×10^{-10}
23	46.26	18.28	35.00		6.2×10^{-10}
	Noticed C_3 scaler not registering properly — change to 256 and check seems OK.				
28	46.26	18.28	36.00		6.5×10^{-10}
37	46.26	↓ 29.75	~~40.00~~		
40	96.26	29.75	41.00	1.0033.5	6.5×10^{-10}
41	Dump Solution				

#191 Repeat Counter Traverse

	level	Rod	Counter	NlnN	Temp
10^{40}	Start solution	Source in, first Trip checked.			
	26.91	29.75	41.0		
44	30.22	7.80	4.0		
52	40.5	7.80	4.00	$.8\times10^{-12}$	
58	54.07	7.80	4.00	2×10^{-11}	1.00437 Source out, on positive period
05	54.07	7.80	4.00	5×10^{-10}	
10	46.26	15.00	4.00	7×10^{-10}	1.00434 Start Counting Traverse
11^{26}	46.25	15.00	10.00	7.7×10^{-10}	
11^{36}		↓ 12.95	14.00	7.5×10^{-10}	
11^{52}	46.252	11.97	19.00	7.6×10^{-10}	
11^{59}	46.252	13.01	21.00	7.5×10^{-10}	
12^{08}	IC-3 Recorder (out of order) turned off				
12^{27}	46.254	15.01	29.00	7.5×10^{-10}	
12^{37}	46.255	25.70	32.00	7.2×10^{-10}	1.00412
12^{53}	46.26	30.88	38.00	7.7×10^{-10}	1.00417

#192 $U_3^{235}O_8$ Foil run. bare and Cadmium Covered

	level	Rod	Foil Pos.	Temp	
2^{55}	Start solution				
56	28.2	30.88 ↓		40.02	
58	29.9	~~30.88~~ 7.79			
313	On positive period, remove source.				
	53.43	7.79		40.02	1.00249
3'	level at 3×10^{-10} on NlnN				
$3^{20\,40}$	Start foils into center of cpture. Rod also to compensate the reactivity				
3^{23}	Start timing exposure foils in center.				
25	46.22	10.92 ↓	00.00		1.00245
27	46.21	9.82 ↓	00.00		
29	46.21	10.35 ↓	00.00		
33	46.21	10.81 ↓	00.00		NlnN
40	46.21	11.44	00.00	1.00245	3×10^{-10}
343	Dump solution 20' minute exposure on Oxide foils				
	#3 Cd Covered 1" below center				
	#2 Bare 1" above center				

Jan 14, 1959

#193 Report Counter Traverse Dwgn. C.C.
Counters were re installed, no possibility of them touching anything as the counter moves out. Will wait ~30 sec ~~between~~ after moving counter to be certain that all vibration is damped. Sig level will be turned off during counting ~~interval~~ Traverse after leveling

January 14, 1959 Dust trips checked OK, Source In.

	Level	Rod	Counter	Temp	N ln N
9[12]	~~27.08~~ 26.94				
		7.81	4.00		.4 x 10⁻¹²
9[13]	Start pumping solution				
9[28]	36.6	7.81	4.00		.55 x 10⁻¹²
36	43.2	"	"		1.5

Shut down -- C_2 shorted out
leak in tip.

Jan 14, 1959

#194 Counter Traverse Dwgn C. C
5-3 replacing 5-1 as C-2 fixed counter.

	level	Rod	Counter	Temp	N ln N	
12[49]	Start Pumping solution					
52	30.2					.4 x 10⁻¹²
1[01]	39.	7.81	4.00			.65 x 10⁻¹²
~1[12]	Critical at ~ 2 x 10⁻¹¹ and approx level to check counters. Slope inspection of pulses from C_3 indicate pulses from noise. Found loose cable on C_3					

#195 Counter Traverse Dwgn ERR C.C.

1[43½]	Start pumping solution, source in Scram set.				
50	33.	15.02	4.00		
2[00]	53.36	7.79	4.00	1.00335	1 x 10⁻¹¹ source out
	Rising on Pos Period.				
2[08]			23.00		2 x 10⁻¹⁰
~2[13]	~~46.44~~	14.98	4.00	1.00345	7.5 x 10⁻¹⁰
2[17]	46.31	14.98	4.00	Start Counting and Traverse.	
2[23]	46.30	12.66	5.00		7.0 x 10⁻¹⁰
2[32]	46.30	13.6	9.00		7 x 10⁻¹⁰
2[53]	46.30	11.98	16.0		7 x 10⁻¹⁰
3[14]	46.30	11.98	23.0		7 x 10⁻¹⁰
3[23]	46.30	13.09	26.0		7.4
3[29]	46.30	13.99	28.0		7.5
		15.58	30.0		
		16.74	31.0		
		18.46			

	Level	Temp	Rod	Counter		
3:47	46.30		19.15 ↓	34.00		
50	46.30		25.00	35.00	8.0×10^{-10}	
59	46.30	1.00373	35.06	38.00	8.1×10^{-10}	
4[10]	Dump Sol/N					

C_3 N 48000/2' ~~N 1881~~ 0 24,000 %/Min @ 23

1-15-59 Took samples #79 #80 and 81 with 50 ml pipettes.

RUN #196 1-15-59 Dwgn. C.C.
(Inst Trips checked)
U-233 foils 1 and 2, #1 Cd Covered 1" below center when rod lowered to 0. #2 Bare 1" above Center when rod lowered to 0.

	Level	Rod	Foil Rod	N/n/N	Temp
10[39]	26.94	47.00	40.0		
10[40]	Start Pumping Solution				
49	34.4	47.00	40.0	$.5\times10^{-12}$	
55	40.6	"	"	.85	Start source sinking out
1100	On Pos: Five Period Source out				
11[00]	51.96	47.00	40.0	3×10^{-12}	1.00452
07	51.96	"	"	3.5×10^{-11}	1.00451
12	51.96			2×10^{-10}	1.00459
13	start foils in to assembly				
11 16	Start timing foil exposures				
11 17	46.46	47.00	99.999	3.1×10^{-10}	1.00436
25	46.40				
36	Dump solution.				

26.160e

Run #197 Jan 15-1959 Dwgn ec
Foil exposure (U-235 bare and Cd covered) approximately at 5" from Top ↓ edge. Power level ~10^{-9}
Selsyn = 40.00 foils at Top flange

	Level	Rod	Foil Rod	Temp	N/n/N
1[25] PM	Start solution, Source in screams set.				
1[26]	27.6	47.00 ↓	30.00 ↓		
29	30.2	7.79	16.00		
34	35.6	7.79	16.00		$.6\times10^{-12}$
43	Sphere full source out			Pos Period	
44	51.85	7.79	16.00	1.00429	6×10^{-12}
50	51.84	7.79	16.00		1.2×10^{-10}
1:52	Start Timing exposure at				0.37×10^{-9}
	51.84	7.79	16.00	1.00429	
2[00]	46.15	24.30	16.00		1.0×10^{-9}
21	46.10	24.30	16.00	1.00434	1.05

U-233 Counters #1 and #2 received from Zeller, Inst Shop and installed

U-233 #2 set at midplane using counter probe rod at 26.00 inches when active region of counter is at midplane

U-233 #1 set at 18" below midplane for normalization. Two runs to be made #2 at midplane bare and cd covered.

Run #198 Checked Inst Trips

Preliminary check out of U-233 counters.

	Level	Rod	Counter	Temp	N/n/N
3[54]	46.58	24.30	26.0	1.00587	1.4×10^{-11}

N/n/N = 1.7 $\times 10^{-11}$ for the 10' count on C_2 and C_3

C_2 U-233 #1 @ 18" below Midplane $139 \times 16 + 7 = 2231$ C/M

C_3 U-233 #2 @ Midplane $547 \times 16 + 12 = 8764$

U-235 C_3 $\frac{24000 \text{ C/M}}{8.0 \times 10^{-10}}$

U-233 $876.4 \times \frac{8.0 \times 10^{-10}}{1.3 \times 10^{-11}} = 53,898$ $\frac{6.15 \times 10^{+1}}{}$

or approx double counting rate of 235 chambers.

4[07]	46.66	24.30	26.0	1.00586	1.3×10^{-11}

Dump solution

lowered thermostat from 74 to 66.

1-19-59 #ERR #199

U-233 Counters bare. #1 @ 18" below midplane for normalizing #2 at midplane to be later cad covered.

Temperature dropped only 3° F

	Level	Rod	Fission Counter	N/n/N	Temp
12[13] PM	Start pumping solution				
16	30.0	24.30	26.00		
23	38.6	"	"		
35	45.18	24.30	26.00	Source out near crit @ 3×10^{-12} 3×10^{-12}	0.9955

Raise solution to full

39	47.73	24.30	26.00	

2' Count Time

Start counting while on Pos Period @ 2×10^{-11}

C_2 $7 \times 256 + 107 = 1899$

C_3 $28 \times$ " $+ 141 = 7309$ $\rangle$ C_3/C_2 3.849

Start Count while on Pos Period @ 1.3×10^{-10}

C_2 $48 \times 256 + 206 = 12,494$

C_3 $191 \times 256 + 28 = 48,924$ 3.986

Level by draining solution to 45.09

C_2 $112 \times 256 + 248 = 28920$

C_3 437 " $+ 157 = 112029$ 3.874

45.09	24.30	26.00	7×10^{-10}	.99547	→ 23.82

C_2 $113 \times 256 + 136 = 29064$

C_3 $434 \times + 22 = 111120$ 3.823

50	45.06	24.30	26.0.	

C_2 $112 \times 256 + 109 = 28,181$

C_3 $433 \times + 25 = 110,873$ 3.852

55[4]	Dump	C_2 $113 \times 256 + 187 = 29,115$		3.800	Av 3.837
		C_3 $432 \times 56 = 110,648$			

1-19-59 # 200

Taped 2½" x ¼" ID Cadmium Tube to top of #2 U-233 counter

	level	Rod	Counts Fission	N/n N	Temp
1 28	32.2	7.79	26.00		
1 05	Crit, rising on positive period with				
1 48	45.85	24.86	26.00	7.4×10^{-10}	.99138

	C_2 (x25)		C_3 (x256)			C_3/C_2
5' Count	279 x 256	+ 229	62 + 245	71 653	16 117	.2249
"	279	+ 80	62 + 29	71 504	15 901	.2224
"	288	+ 226	65 + 210	73 964	16 850	.2278
"	288	+ 170	64 + 128	73 898	16 512	.2234
						.2246
	45.74	24.06	26.00	7.1×10^{-10}	.9914	

2 12 Dump Solution

$\frac{Cd}{Bare} = \frac{.2246}{3.837} = 0.05854 = \frac{1.717\lambda}{1+1.991\lambda}$; $.0585 + .118\lambda = 1.717\lambda$

$\lambda = \frac{.05854}{1.600} = .0366$

U-233 Foils $\frac{Cd}{Bare} = 0.06155$

1-19-~~60~~ EXP #201

Removed Counters

Purpose of run to determine excess react. at this lower temperature.

	level	Rod	N/n N	Temp
3 00 PM	Start feeding solution Norm ENRICH			
05	33.0	47.01	1.7×10^{-12}	$.5 \times 10^{-12}$
15	Source out, near critical			
16	45.00	47.00	2.8	3.5
~~19~~	Checked Calib of N/n N/EN/n N, Sphere full			
~~20~~	47.74	47.01		.9906 on Pos Period
~~23~~	47.736	47.00		$\frac{.9906}{.9720} = 22.56$

Let Power rise Trip Keithley scram to shut down — Test of scram. Keithley Meter scrammed!

	S	T
Exp #201	10.24×10^{-4}	22.56
200	6.64×10^{-4}	22.76
199	7.95×10^{-4}	23.82

} these temperatures possibly N & one S mixing.

Change thermostat setting from 66 to 74

EXP # 202 1-20-53 Alon C.C.

Checked Inst Trips. — Source In

	Level	Rod	N/n N	Temp
9:24	Start Pumping solution.			
:29	32.5	47.01	$.4\times10^{-12}$	
40	47.0			
41	47.8	Drain back to previous reading #201		
42	47.738	47.01	.99420	Rising on + Period Source out
44	47.730	47.01		
	Dump solution			

EXP # 203 Repeat above

9:47	Start pumping solution, source in.				
58	40.0	47.01	$.9\times10^{-12}$		
	47.86	"Sphere fuel" source out, drain back to			
10:05	47.744	47.01	"	.99427 = 23.50	+ Period
10:08	47.740	47.01	8×10^{-10}	.99426	

Lift trips Scram assembly

EXP # 204 1-21-58 CC DW Jm

Checked Trips OK Source In

#4 U-235 UO_2 Counter at mid plane Cd Covered

#1 U-233 Counter at 18" below mid plane for normalizing.

12:56PM Start Pumping solution, source In, scram set

	Level	Rod	N/n N	Temp
57	28.9	47.01	3×10^{-13}	1.0083 (Rm Temp)
05	37.9	47.01	4.6×10^{-13}	
11	48.69	↓	4×10^{-12}	Remove source ~~Insert~~ Sub
13	48.70	7.78		Slightly super critical
	Insert source.			1.00245

Remove source at 1×10^{-10} continue raising power on slow period.

at 2×10^{-9} on N/n start to level

Raise rod but power increases, dump solution to level

1:44	47.67	43.44	2×10^{-9}	1.0025	
1:44.5	start taking 5 Min counts				
	C'-2 (256)	C-3 (64)			
	936 + 51	310 + 56	239 667	19 896	.08302
	937 + 171	313 + 17	240 043	20,049	.08352
	925 + 127	307 + 25	236 927	19,673	.08303
	919 + 20	307 + 47	235 284	19,695	.08371
2:08	Dump soln				.08332

EXP #205 1-21-59 Dunn CE.

#4 U-235 Bare @ Midplane
#1 U-237 18" below midplane (untouched since #204)

303 Start pumping solution.

	level	Rod	Temp	N ln N
06	30.35	7.78		
20	48.19	7.78	1.0029	Remove source
21	48.18	7.78		1.8×10^{-11}
	Leveled @			3.0×10^{-10} by
	dumping solution @ removing rod			
30	46.47	39.93	1.00284	3.6×10^{-10}

32½ Start Counting C_2 and C_3

37 46.35

$C_2\times64$	$C_3\times256$			
465 + 29	477 + 13	~~29 789~~ ~~#9 669~~	122 125	4.100
480 + 62	493 + 221	30 782	126 429	4.107
481 + 21	494 + 109	30 805	126 573	4.109
470 + 58	481 + 208	30 138	123 344	4.093
				4.102

3:55 Dump Sol'n

$$\frac{\text{Cd Count Rate}}{\text{Bare Count Rate}} = \frac{.08332}{4.102} = 0.0203$$

$$.0203 = \frac{.657\lambda}{1+.852\lambda} \qquad .0203 + .017_3\lambda = .657\lambda$$

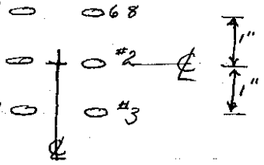
$$\lambda = \frac{.0203}{.640} = .0317$$

Foils 0.023_{45}

The next two runs are designed to investigate U-235 foil self shielding 2 mil 37% U-235 foils and 2 mil U-235 foils will be irradiated singly and stacked to check for foil shielding and flux depression.

EXP #206 1-23-59 Dunn C.P. Data Checked OK

4 0.002-37 and 2 - 0.002-93 U-235 foils were mounted with 1" separations and suspended on nylon string from control rod. Rod = 0 corresponds to foils at center of sphere.



Rod @ 41 Foil center 2" below Top flange

	level	Reflector Rod	Rod Foil	Temp	
1'5	26.878	39.93	41.00	1.00204 (Rm)	
15+	Start pumping solution	↓ 7.78			
34	48.18	7.78	41.00	1.00960	$\sim 4\times10^{-4}$ On + Period Source Out
37	48.17	7.78	41.00	1.00958	
38		Start to level — with rod and sol. drain.			
40	46.79	36.03	41.00		~ level
40'35"	Start foils in to sphere center.				
~~43~~	~~Start timing foil exp.~~				
~~43~~	~~00.00~~				

Shut down. Foil rod hit tube for mounting counters.

Removed tube!

EXP # 207 Dwn WCT C.C.

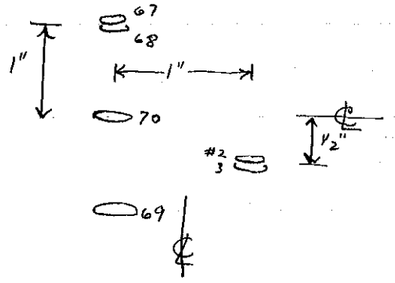
Foil exposure see #206

	level	Rod	Foils	Temp	N/n/N	
1 55 PM	Start Pumping solution Source dn.					
00	30.4	7.78	41.00			
12	46.9	7.78	41.00			Source dn, remove Source
14	48.14	7.78	41.00			On Pos Period
19	Start to level.					
21	46.96	36.00	41.00	1.00572	1.0×10^{-9}	
22 40"	Start Foils into					
25	Start timing foil exposure.					
	Foils and holder contribute negative react.!					
26	45.78	36.00	00.00	1.00584	1×10^{-9}	
33	45.78	36.00	00.00	1.00580 1.00600		
45	Dump solution and raise foils ~10"					

1-26-59 EXP# 208

Foil exposure, compare to 206.

#67 #68 were saved from their Teflon Tape protective covering and remounted as a sandwich foil of 2 foils. Similarly #2 & 3 were remounted. The foil holder will be centered when rod @ 0.00



Inst trips were checked.

	level	Rod	Foils Position	N/n/N	Temp	
	26.87	7.78	41.0			
10 28	Start adding solution, Source in, Scram set.					
34	33.241	7.78	41.0	4×10^{-12}		
	Source out, spheres full			on positive period (Rod out)		$S = 5.87\times10^{4}$
45	48.04	41.29	41.0	$\sim10^{-11}$	1.0114	
54	45.62	41.29	41.0	3×10^{-10}	1.0112_0	~level
						$T = 27.91$
54 40	Start Inserting foils with rod.					
57	Start timing foil exposure (3×10^{-10})					
58	45.61	41.29	00.00	3×10^{-10}		
11 10	45.61	41.29	00.00	3×10^{-10}	1.0111_5	
11 17	Dump solution raise foils to 10.0					

1-30-59

U-233 in 5" bottles reads ~ 1½ to 3½ R/HR on cutie pie at surface. 8 bottles were stored in vault each containing less than 2kg.

Lead shields 4" thick were built in front of IC3 and IC-1 and IC-2, thus all instruments now have lead between them and the system. The gamma background from half of the U-233 in the room (4 bottles ~ 8 kg) was excessive. and made necessary the lead shields. The larg neutron source Ra-226 was hung outside the sphere at mid plane. All counts to be taken with small source in pig!!

				Total
1[15] PM	Start adding UD-22	#4	1,940 g	1.940
2[00] PM	Start adding UD-22	#2	1,844	3784
3[05]	Start pump circ thru sphere			
3[40]	Stop circ thru sphere			
3[45]	Start adding	#3	1769 g	5553 g
4[30]	Stop adding	#3		

2-2-59

Background count before mixing.

5' C_1 = 92 x16 +7

5' ~~C_2 = 300 x64 +31~~

8[33] Start Mixing by pumping from tank to top of sphere.

9[00] Start filling sphere Rm Temp = .9971 s

end EXP Prod # 209

9[00]	25.10	41.29	
02	27.4		
06	32.1		NEnN = 1.2 x10⁻¹²
12	39.86	tank empty.	ENEnN = 2.7 x10⁻¹²

5' C_1 = 73 x16 +0

5' ~~C_2 = 300 x64 +32~~

9[19] Dump solution

			Total
10[11]	Start adding	#1 to tank	1891 g 7,444 g

Bkg Count w mixed solution of #209 in sphere while adding #1 to tank

10[40]	5' C_1 = 94 x16 +15	.98	
	5' ~~C_2 = 304 x64 +42~~	.994	
11[15]	5' C_1 = 96 x16 +13	.96	av 97
	5' ~~C_2 = 304 x64 +2~~	.987	99
11[42]	#1 U-233 completely Transferred To Tank		

2-2-59

11[44] Start circ into sphere

12[14] Start Filling Sphere

EXP # 210 Dwn C.C.

	Level	Rod	N ln N (Red)	E ln N (Blue)	Buck	Keith
12[14]	25.4	41.29	1.7×10^{-12}	2.5×10^{-12}	1.6×10^{-12}	1.35×10^{-12}
12[16]	27.65					
12[26]	40.70	Tank Empty	1.2×10^{-12}	3.2×10^{-12}	1.85×10^{-12}	1.35

$C_1 = 78\times16+14$ .936

~~$C_2 = 302\times64+37$~~ .993

12[33] Drain thru fast feed.

(17' left on collection period of ∝ sampler.

Previous dump increased room background

∫∝ cont. to 5000 scale on inst. ~ 10 × tolerance

17' sample → 800 cpm

∴ 35' sample → 1600 cpm ~ 3 × tolerance (500 cpm)

Since drain rate is smaller than feed rate the sample is probably representative and should not be doubled.

105 Found 60 N on scaler C_2

				Av
C_1	$97\times16+13$	$96+7$	$94+6$	96
C_2	$251\times64+52$	$265+53$	$258+7$	258

25.58 Close dump valve

1[43] Start adding bottle #5 17299 Total 9173

Drain valve closed. ~9.659/l

5[40] Start Mixing By pumping So/N into top of Sphere

4[10] open during wash

Stop Mixing

EXP #210 C.C. Dwn.

	Level	Rod	IC-3 N ln N	IC-4 E ln N	Buck IC-2	Keith IC-1
4[10]	26.02	41.29	2.4×10^{-2}	2.6×10^{-12}	1.75	1.45
4[11]	Start filling sphere.					
4[16]	32.37		2.6	2.6	1.9	1.45
4[20]	37.40		2.7	3.2	2.0	1.45
28½	41.60	Tank empty pump off.	Sub Crit	T = .9963	= 24.04°C	
25	Start	Counting	2.6	3.6	2.05	1.45

C_1 $85\times16+9$ → .859

C_2 $229\times64+13$

C_1 $81\times16+0$ → .901

C_2 $232\times64+49$

C_1 76 +3 → .96

C_3 240 +36 Av .934

12 41.60 ~~of Feed Valve to Main~~

42½ Dump solution with energy exhaust on - 5' sample counted 750 c/min

52½ exhaust off Next 7' " collected after dumping counted less than 10 c/min

2-3-58

Cond

8⁴⁵ 26.41 C_1 = 100 x16 +0

C_2 = 282 x64 +11

9⁰² Start adding Bottle #6 to tank 1,896g (9177 Total 11,069)

9⁵⁵ Stopped adding because of air activity. This activity was thought to be krassins but seems to be about the same level as found with other additions.

10⁵⁴ Start adding solution to Tank Bottle #6 ∠ sampler 20' to go before change on X1000.

11³⁵ #6 in tank

11⁴² Start Circ thru sphere.

1200 C_1 105x16 +7

C_2 317 x64 +32

1206 C_1 108 +10

C_2 323 x64 +30

12¹¹ C_1 110 +8

C_2 323 +23

Cond Rad EXP #211 (Just Checked) Duffy C.C.

12¹² 26.45 Start filling Sphere IC-4

16 31.2 41.29 1.7×10^{-12} 2.3×10^{-12} 2.2×10^{-12} 3.0×10^{-12}

26½ 42.54 41.29 1.9 2.65 2.4 4.4×10^{-12}

C_1 107x16+4 → .68

C_2 341x64+39 .69

2-3-58

12³⁴ C_1 100 +6 .73

12³⁹ C_2 339 38 → .690

Air pressure failure drained system

26.47

12⁴³ Turned on Emerg exhaust

26.47 C_1 107 +1

C_2 328 +54

12⁴⁹ Energy for 5J.

Add 30-32 ℓ H_2O rapidly to Tank

1³³ 27.27 EXP #212 pump in to Sphere

		(Rad)	IC-1	2	3	4
1³⁵		41.29	1.9×10^{-12}	2.25	1.6	2.8×10^{-12}
40	35.61	41.29	#9	2.55	1.85	3.7
47	44.75	11	1.9	2.60	1.7	4.4

C_1 101 +2 .72

C_2 296 +60

C_1 99 +3 .74

C_2 293 +50

C_1 100 +1 .73

C_2 295 +38 av 295 → .793

2²⁷ Start #3 bottle into Tank ~950g = 12019g Total

3⁰⁰ Stop adding

3⁰⁸ Start Mixing into sphere.

3¹⁵ 35.0 Stop Pumps drain back.

2-3-59

3²³ Start mixing again. 12.02 kg

3⁵³ Stop Mixing

EXP# 213 Dwn. C.C.

3⁵³ Level Rod Ic 1 2 3 4 Temp

27.51 41.29 2.1×10^{-12} 2.45 1.8 4.0×10^{-12}

3⁵³ Start filling Sphere

57 32.3

4⁰¹ 37.4₀ 2.4 2.95 2.2 5.0

4⁰⁷ Sphere nearly full Tank empty

45.46 41.29 3.3 3.8 3.0 8.8 .9926₂

= 23.08°C

4⁰⁸ / 4¹³	C₁	267	x16	+4	.273
	C₂	927	x64	+32	.252
4¹⁴ / 4¹⁹	C₁	264		5	.277
	C₂	943		32	.248
4¹⁹ / 4²³	C₁	267		13	.273
	C₂	936		7	

Av. .274

Dump slowly manually operating dump valve with exh. fan on.

2-4-59

8²⁹ Start Mixing thru Sphere

9²⁹ Stop Mixing

N.B. Mixing as above does increase α activity in Rm Air.

#214 (Repeat of #213 after additional mixing)

Dwn. C.C.

Level Rod Ic-1 Ic-2 Ic-3 Ic-4 Temp

27.50 41.29 2.0×10^{-12} 2.4 1.9 3.0

9³³ Start filling sphere

38 33.6 2.15 2.7 2.4 4.0

9⁴⁷ 45.488

9⁵⁴ 45.488 $3.7 \times 10 \times 10^{-12}$ 3.2 3.0 8.5 .9277

	C₁	261	x16	+11
	C₂	927	x64	+45
~9⁵⁷ / 10⁰²	C₁	264		11
	C₂	940		47

Dumping the 36" gave ~1670 c/min

" after 36" gave no activity Total

Add 2/3 of remaining U-233 in bottle #13 637g 12656

Add 30 ℓ H_2O (amount of uranium for enriching solution is only 258g) the remainder brings the 30 ℓ H_2O up to concentration of 12.6 g/ℓ

~10¹⁵ Start adding U-233

11⁰⁰ Start adding H_2O

11²⁶ Start Mixing thru sphere.

12²³ Stop Mixing

2-4-59 Check Inst and turned to Corridor Rx. EXP #215 Down C.C

	Level	Rod	IC-1	2	X	4	Temp
	28.40	41.24	2.0×10^{-12}	2.5	X	3.7	

12 23 Start pumping solution into sphere both ways thru stopcocking feed valve and thru circ line to sphere.

12 30 36.24 41.29 3.0 3.5 7.0

31 Drain back thru feed valve

34 Close feed valve

35 34.96 41.29 2.6 3.2 5.5

35 Start adding solution to sphere stg @ 38"

39 38.07 41.29 3.5 4.0 9.0×10^{-12}

Drain to 37.5 Instruments dropped

41 Add to 39.6

45 39.68 4.6 4.9 13×10^{-12}

Drain to 39.0 Inst dropped

Add to 41.0

50 40.95 $2.1\times3\times10^{-12}$ $2.2\times3\times10^{-12}$ 1.9×10^{-11}

51 Drain to 40.0 Inst dropped

Add to 42.0

57 42.08 $3.8\times3\times10^{-11}$ $3.5\times3\times10^{-11}$ 3.7×10^{-11}

Drain to 41.5 Inst dropped add to 43

105 42.98 Rising on large period not above source log N shows curvature $\sim10^{-10}$

Add to ~ 43.5

110 43.29 Rising on large period, period shows curvature not above source ~ 326 sec $= 1.30\times10^{-4}$

111 Drain thru feed valve

2-4-59

136 Start circ thru sphere for additional mixing. Remove M-226 source use M-228 in pig in drum.

214 Stop Mixing, pump up in sphere.

EXP #216 CC Down.

	Level	Rod	IC-1	2	3	4	Temp
215	28.36	41.29	1.4	1.9	1.2	1.8	
215	Start pumping into sphere						
24	39.59		1.9	2.6	1.7	4.4	
31	42.84		3.1	3.7	3.0	9.5	
35	43.45						

Pulled source part way drifting down scale

43.68 Remove source very near critical

37 43.68 41.29 4.8×10^{-12} 5.0 4.3 16×10^{-12}

42 43.82 Slightly super .99234

45 44.26 On positive period } T = 184.7 sec

check for linear rise on log N } S =

50 44.26$_3$ 41.29 + Period

56 44.05$_0$ level 1.2×10^{-11} 4.9×10^{-11}

Drain thru feed value

Dump to 28.38 close drain Valve

Add 12L H_2O } EMERG Fan On

345 Start adding H_2O

353 Start mixing

level read. 28.66

445 Stop Mixing

2-5-59 DWM C.C. Inst Checked & Source In
EXP # 217

	level	Rod	IC-1	2	4	Temp
8^{30}	28.72	41.29	1.4×10^{-12}	1.9	2.0	
8^{30}	Start filling sphere					
34	33.20		1.5	2.2	3.0	
38	38.75		1.7	2.4	4.6	
41	43.7		2.3	2.9	7.2	
9^{00}	48.78	7.76		3.15	8.0	99162

Sub critical!

Drain back thru feed valve

Added ~1" from #3 or 50g U

10^{00} ~~start~~ Continue mixing in Tank
28.74

10^{20} Start Mixing thru Sphere.

10^{30} Stop " " " Set valves so that one adds only three feed valves.

2-5-59 DWM C.C.
EXP # 218

28.78 1.3 1.9 1.7 2.0

11^{47} Start filling sphere

level	rod	IC-1	2	3	4	Temp
52	34.00	7.76	1.8	2.15	1.8	2.9	
58	41						
12^{03}	50.556	7.76	2.4	3.0	2.7	7.5	99295

Not as much multiplication as last exp. #217

Remove source and insert source (Small one

12^{09} C_1 164 x16 +10

12^{14} C_2 601 x64 +53

Drain by dumping slowly.

Add ~1" from #3 or ~50g U

12^{33} pm Continue mixing in tank.

1^{11} Stop " " "

1^{14} Start Mixing thru sphere

2^{14} Stop " " "

28.75 level

2-5-59 DwMcC
EXP #219

2[16] Start filling sphere after this mixing.

	28.75	Rod	Ic-1	2	3	4	Temp	
21	34.40	7.76	1.5	2.2	1.8	3.0		
35	52.13	7.76	5.9	6.0	6.5	22.0×10^{-12}	.9937	
39	52.13	30.25	3.2	5.4	5.5	19		
		Subcritical		Remove Source.				
		30.25	3.6	4.0	3.8	13×10^{-12}	.99379	Source
~~3~~ 00	52.13	7.76	6.6	6.5	6.5	25×10^{-12}		
		Shut down		Change Temp setting				
		on Rm thermostat to 60°F						

3 19½ PM Start Mixing thru sphere. to be sure before any more Uranium is added.
3 49½ PM STOP

EXP #220 DwMcC

	28.73	7.76	1.4	1.95	1.7	2.0
3 51½	Start Pump into Sphere Source					
4 03 PM	42.93	7.76	1.8	2.6	2.3	6.0
4 07	52.29	7.76 Sphere Full	4.9	5.0	5.0	19 .9934
4 20	52.30	7.76	6.7	6.5 to 40	6.5	25
4 21	Drain thru feed valve, and Dump slowly.					

2-6-59

add 1½" $UO_2(NO_3)_2$ Soln ~25g U

8 05 Start mixing in slab tank
9 21 Stop mix in slab Tank
9 23 Start mix thru sphere
~9 50 Found dump valve closed dumped
~~10 55~~ Stop mixing. Chuck Inst.

EXP # 221 DwMcC.

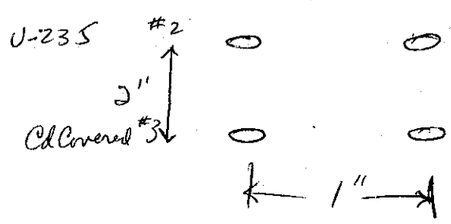
11 ~~04~~ 12 AM Start filling sphere 28.735 Source in

	level	Rod	Ic-1	2	3	4	Temp	
	28.735	7.76	1.35×10^{-17}	1.95	~~2.0~~ 1.5	~~3.1~~ 2.0	Rm Temp	
11 16	32.80	7.76	1.5	2.15	1.7	2.8	.98697	
23	41.43	7.76	1.8+	2.65	2.0		.98682	
	Critical on Pos: 1/1.0 Period! Source out							
33	52.07½	25.52	Rising at Period					
38	~~47~~ 52.076	25.52	7.4	6.3	7.0	2.9	.98683	~level

Level reads ~50 when full since manometer arm has H_2O in it. 21.5°C
$\rho = 3.04_{\times10^{-1}}$

12 00 Start mixing thru sphere!
2 00 Stop Mixing thru sphere!

2-6-59 Mounted foils as follows



28.756

EXP # 222

level	Rod	IC-1	IC-2	3	4	Temps
2^{26} PM	Start adding solution to sphere					
31	34.3	40.20	1.4×10^{-12}	2.2×10^{-12}	1.7	3.0
35	39.3	"	1.65	2.4	1.9	4.5
49.8	sphere full source out Positive Period start @ 52					
2:46	52.19	40.2				.98815
51	52.20	40.2	$5\times3\times10^{-10}$	7×10^{-10}		98810
53^{35}	Start foils into sphere.					
~256	Start timing foil exposure.					
309	49.087		$5.5\times3\times10^{-10}$	7.5×10^{-10}		.98830
316	Shut down by dumping ~22,000 cm			with exc for Dr		21.93°C
						$\rho = 2.80\times10^{-4}$

2-9-59

8^{50} Start Mixing for temp equilibrium (Pump H_2O out of liq. level with squeeze bulb twice - three times and allowed to fill with soln. ∴ liq. level reading should be reasonably accurate)

8^{55} 28.229

10^{00} Pump OFF Stop Circ. Check Init Source In

EXP # 223 D.W. C.C.

Check of Critical excess react vs Temp.

level	Rod	IC-1	2	3 *	4	Temps
28.239	40.20	1.35×10^{-12}	1.95	1.3	1.9	
10^{14}	Start filling sphere thru feed valve only					
10^{20}	32.		1.4	2.1	1.5	2.4	1.00431
	Sphere full @ ~~49~~	Remove Source				
10^{33}	52.175	40.20	$.7\times10^{-11}$	$.2_6\times3\times10^{-11}$	7.0	1.9	Rising
	on a very long period. Insert Rod to increase power					
10^{48}	52.183	7.77	6×10^{-11}	5×10^{-11}	5.0×10^{-11}	2.3×10^{-10}	1.00310 Rising
				#1 + Period		
10^{59}		41.05		#2 - Neg.		25.82°C
11^{01}	52.191	41.05				1.00316
11^{09}	52.203	7.77		#3 + Period		
11^{17}	52.210	7.77		"		1.00333
21		41.83		#4 - Period		avg = -.98
11^{29}	Drain thru Feed Valve					FINIS

July 1st Ra / July 21 1969

	σ_a	g_a	$\sigma_a g_a$	$\overline{\sigma}$ .886 03	RI_a	λ_c = .015 × 428/395.6 = .0162 ; .707 σ_a(f) + RI_a(238) + RI_a(240)					
233	575.6	.9962	573.4	508.2 (4.3)	1073.6	3.0	512.5		1.033 94	.2627	+1.0239	1.2866
235	679.5	.9978	664.4	588.8 (0.2)	560.3	2.	589.0		1.015 41	.2965	+1.0291	1.3256
239	1012.0	1.0809	1093.9	969.4 (N 3.1, 4.4, 1041.2)	2736.1	83.1 N	1081.1		1.041 00	.5578	+1.6762	2.2340
			? 240		RI(240) 134.0							
	σ_f	g_f	$\sigma_f g_f$	$\overline{\sigma_f}$	RF_s	$RI_f/\overline{\sigma}$	$1+\lambda RI/\overline{\sigma}$		1.045 60	.5135		
										×1.0455		
233	530.8	.996 a	528.7	468.5	920		1.03181			=.5369	+1.6762	2.2131
235	580.5	.9760	566.6	502.1	395.6		1.01276					
239	741.6	1.0555	782.8	693.7	1664.7		1.03888					
			Σ RI									
239	$\overline{\sigma_{at}}$											

$\frac{n\sigma(3)}{n\sigma(5)} = \frac{1.2866}{1.3256} \times \frac{1.01276}{1.03181} = 0.9529 \rightarrow 0.953 \pm 0.014$

$\frac{n\sigma(9)}{n\sigma(5)} = \frac{2.2131}{1.3256} \times \frac{1.01276}{1.03888} = 1.6313 \rightarrow 1.631_3 \pm 0.023$

	$\overline{\sigma_{at}}$	RI_s	$\overline{n\sigma}$
239	969.4	2736.1	
240	4.4	134.0	
N	61.6	43.5	
S	.9	.6	
	1036.3	2914.2	
		2.812	
		1.0456	

Original

239	958.9	2455.	
240	4.4	134	
N	61.6	43.5	
S	.9	.6	
	1025.8	2633.1	
		2.5669 × .015 = 1.0385	

1025.8 × 11 / 9553 = .5083 ; 1.03888 ; .5279 + 1.6762 = 2.2041

$UO_2(NO_3)_2$ + HNO_3 — 233 — .977 — .932 — .924 — $\frac{N}{Pu}$ = 1. — $\frac{S}{Pu}$ = 2 — S = 0.51 — $\frac{3.479}{1.211} \times \frac{239}{63} = 6.26$ — $\frac{N_8}{N_3}$ = .0235 — ×2.72 = .06 — $\frac{N}{U}$ = 2.6 — ×1.88 = 4.9 — ×.886 = 4.3

UO_2F_2 — 235 — .983 — $\frac{.017}{.983} = .0173$ — σ_s = 1.0 — ×.886 = .9 — ×188 = 117.6 — ×.886 27 = 104.2 — .068/.932 — .073 × 2.72 = .2

$Pu(SO_4)_2$ + HNO_3 — 239 — $1+\lambda\frac{RI}{\sigma_{at}}$ — $\times C_2 \overline{\sigma_{at}} \times 10^{-20}$ — 2.5

Atoms H displaced per N: 30 c/m/g × 2 = 3.3304 ; 18.01 g/m — ×.9932 = 3.321 — −1 = 2.321 — σ_{Pu} × .322

$Pu(NH_4)_2$ — 1.88 — .886

$\frac{R_{I_s}}{\overline{\sigma_f}} = 565.7$ — ×.8862 — $\frac{428}{501.3} \times .015$ — 1.01281

C_2 = 27.43 counts/g

$I_0 = \frac{.6023 \times 10^{24} \times 7 \times 10^{-24} \times .886}{6.939} \times 1.01327$

$= 5.5355$

C_2 = 4.9553

$\frac{1+\lambda \times .707\,\sigma_a}{.886\,\sigma_a}$ — .0162

$\frac{2.2041}{1.3195} \times \frac{1.01281}{1.03891} = 1.628$

$\frac{664.4}{577.4} = 1.104$ — × 2.076 = 2.292

$\frac{664.4}{1093.9} = 0.9908$ — × 2.076 = 2.056 — ×.9964 = 2.106

?

1.3195 = 1.0239 + .2956

3-5237

$\frac{RI_f}{\sigma_f \delta_f}$ (235) = $\frac{428}{565.4} = .7564$; 233 = $\frac{532}{527} = 1.7847$; $\frac{395.6}{566.6} = .6982$; $\frac{920}{528.7} = 1.7402$

		$N\bar{\sigma}_{ax}$ / $5R_0$	Σ_{ax}	f	$\sigma_a(\frac{1}{\nu})$	λ	$\frac{\lambda}{.886_{23}}$	$1+\frac{\lambda}{\beta\epsilon_2}\times\frac{\sum RI_f}{\sigma_f \delta_f}$	$N RI_a$	$.707\,\Sigma_a(\frac{1}{\nu})$ / 1	$\times\frac{1}{\Sigma_{ax}}\times\frac{\lambda}{.886}$ / +1	R_0 / R_1 / F	$P(\beta_{\epsilon_2})$	k_2	$P(\beta_F)$	$\eta_{(th)}$	$\eta_{(F)}$	ν
									(235) 560.3 (238) 1073.6									
								(1.02805)	(305.7)	(158.6)	(1.03147)	(0.9965)						
235	(1)	319.35	543.67	.5874	224.3	.03708		1.03082	.0269.3 / .04279	.0158.6	1.03474	0.9962	0.8202	1.00118	0.8266	2.086		2.070
5	2	373.43	637.34	.5859	263.9	.04347		1.03612	.0314.9 / .05015	0186.6	1.04072	0.9956	0.8228	1.00073	0.8290	2.085		2.069
5	3	424.84	728.34	.5833	303.5	.04967		1.04128	358.3 / .05729	214.6	1.04651	0.9951	0.8247	1.00090	0.8309	2.091		2.075
5	4	451.52	773.28	.5839	321.8	.05274		1.04383	380.8 / (.0608.3)	227.5	1.04939	0.9947	0.8254	1.00028	0.8317	2.087		2.071
233	(5)	248.31	471.87	.5262	233.56	.03218		1.00667	.0464.9 / .06510	158.1	1.05058	1.0153	0.8177	1.00050	0.8241	2.290		2.272
3	6	258.84	492.50	.5256	233.66	.03359		1.06958	.04846 / .0649 8	165.2	1.05276	1.0160	0.8185	1.00103	0.8249	2.290		2.272
3	7	268.46	511.70	.5246	243.24	.03490		1.07229	.05026 / .06746	172.0	1.05427	1.0166	0.8192	1.00109	0.8256	2.291		2.274
3	8	222.98	530.65	.5238	252.67	.03619		1.07497	.05204 / .06991	178.7	1.05676	1.0172	0.8199	1.00033	0.8263	2.290		2.272
3	9	287.22	549.39	.5228	262.17	.03747		1.07762	.05377 / .07231	185.4	1.05871	1.0179	0.8205	1.00044	0.8269	2.291		2.274
235	10	240.41	463.73	.5184	223.32	.03163		1.02628	202.7 / .03606	157.9	1.02928	0.9971	0.9308	1.00129	0.9321	2.081		2.078
233	11	191.93	414.86	.4625	222.93	.02829		1.05861	.035 93 / .05169	157.6	1.04196	1.0160	0.9300	1.00046	0.9312	2.289		2.286
235	12	274.82	438.34	.5515	223.52	.03399		1.02825	231.8 / .03894	158.1	1.03166	0.9967	0.8764	1.0000	0.8814	2.076		2.064
5	13	269.71	493.46	.5466	223.75	.03365		1.02797	227.5 / .03857	158.2	1.03131	0.9968	0.8850	"	0.8883	2.074		2.066
5	14	242.19	465.60	.52016	223.41	.03175		1.02639	204.24 / .03622	158.0	1.02991	0.9971	0.9307	"	0.9319	2.072		2.069
5	15	231.51	454.97	.50885	223.46	.03103		1.02579	195.23 / .03472	158.0	1.02868	0.9972	0.9518	"	0.9521	2.071		2.070
5	16	222.70	446.22	.49908	223.52	.03043		1.02643	189.8 / .03459	158.1	1.02808	0.9984	0.9677	"	0.9678	2.074		2.074
233	17	209.39	432.40	.48425	223.01	.02949		1.06109	.03920 / .05497	.0157.7	1.04463	1.0158	0.8855	"	0.8926	2.288		2.278

										$NRI_a(X)$	$.2071\ \Sigma_a(\frac{1}{v})$	$\times \frac{1}{\Sigma_a \phi}$	F	$P(\beta_{FW})$	k	$P(\beta_F)$			
			f	$\Sigma_a(\frac{1}{v})$	$\frac{\lambda}{.886\,23}$														
3 18	200.56	423.60	.47349	223.04	.028 89		1.05985		.03755	157.7	1.04329	1.0159	0.9108	1.0000	0.913 0	2.283		2,277
									.03332									
3 19	190.90	413.88	.46124	222.98	.028 23		1.05847		.03574	157.7	1.04182	1.0160	0.9346	"	0.9355	2.283		2.281
									.05151									
3 20	181.01	403.98	.44805	222.97	.027 55		1.05707		.03389	157.7	1.04032	1.0161	0.9603	"	0.9602	2.287		2.288
									.04966									
235 21	225.50	449.26	.50193	223.76	.030 64		1.02546		190.2	158,4	1.02830	0.9972	0.9618	"	-	2.077		2.077
									.04460									
5 22	220.08	443.77	.49592	223.69	.030 32		1.02515		185.6	158.2	1.02791	0.9973	0.9727	"		2.079		2,079
									.03436									
5 23	214.41	438.58	.49002	223.67	.029 91		1.02486		181,2	158.2	1.02756	0.9974	0.9869	"	-	2.073		2.073
									.03394									
														(13)	$\bar{\eta}$ (5)	2.079		2.072
														(10)	$\bar{\eta}$ (3)	2.288		2.277
															$\bar{n}$ (5)		2.076	
															$\bar{n}$ (3)		2.283	
															$\frac{n(3)}{n(5)}$		= 1.100	

$RI_f(235) = \frac{395.6}{428} = .9243$ Aw $.9568 = 957$

$RS_f\ 233 = \frac{920}{930} = .9892$ $\frac{.682}{.957} = .7126$

19.35