BOOK106R

Notes:
"10153" on bottom edge
also a piece of tape on front with "DFC" wrote on it

Blank pages: page opposite page 1, 2-4, 22, 34, 36-38, 45-47, 145, 148-152, inside back cover sheet

-page 23 has yellow post-it-note with "Cylinder Equipment setup (detectors, source, etc" wrote on it
-pages 33, 129, and 131 have 1 (8.5x11) graph sheet taped to each page

Scanned by:
Sheila Finch
RSICC /Oak Ridge National Lab.
September 15, 1999

SECRET

14-2-2

COMPUTATION BOOK

NAME	Number
K-1095 INTERACTION Exp's	28

NITRATE EXPERIMENTS.

Course .....

Used from 9/28/49 19..., to 11/4/49. 19...

EXPERIMENTS 235 → 314 inc.

Nitrate -238-314.

HARVARD COOPERATIVE SOCIETY
Cambridge, Massachusetts

SECRET

10153

CLASSIFICATION CANCELLED

DATE 5/27/60

For the Atomic Energy Commission

Jacob E. Kahn for the

Chief, Declassification Branch

4C

RESTRICTED DATA

This document contains restricted data as defined in the Atomic Energy Act of 1946.

This document consists of 152 pages,
No. 1 of 1 copies, Series A.

SECRET

This document consists of 154 pages,
No. 1 of 1 copies, Series A.

5-25-60

Experiments 235 —.

page	Exp. #		
5	235	2-10" Al untempd	H/X 320
10	236	2-10" Al tempd	H/X 320
13	237	2-6" Al tempd	H/X 320

H/x = 328.7

Fox
Moffitt
Pressey
Cronin

Experiment 235 - 2 10" Al Untamped @ H/x ≈ 350

Trip Point #6 - 5.5 235A - Contact

	Scale Reading	Actual
Separator	11.6	0
#2 Source Comp	61.7	—
#2 Source	~~10.0~~ 14.0	~~10.0~~ 14.0
#1 Source	~~15.0~~ 19.0	~~10.0~~ 14.0
#2 Control Rod Comp	66.1	—
#2 Control Rod	3.5	0
#1 Control Rod	9	0

9:55 Filling from E

10:10 Checked Zero & Vert back Sight glass is reading 6 mm higher than true level. Due to not tightening up on #1 Cylinder. This is actually advantageous since ~~it~~ ~~corrects~~ Raising the #1 cylinder is equivalent & lowering #2 & 6mm is approximate correction.

10:15 Equilibration Found to be OK. "E" Empty @ 4.0 cm

	H	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
10:23	10.9	—	—	—	—	"F" Empty
10:30	~~H~~ 18.1	~~89~~ 58 58.5 ~~65~~ 39, 41		1.0	1.0	"D" Empty
		(Counts moved →				
						Filling from C
10:40	23.3	108	80	.536	.512	
11:05	25.2					C Empty
11:07	27.9	172	145	.337	.283	From B
11:20	31.7					B Empty
11:25	32.3	303	274	.191	.149	From #9
11:45	36.3	612	561	.095	.073	From #8 (#9 MT
12:00	38.5	1171	1081	.049	.038	8 MT
12:58	40.4	NOT CRITICAL Both Rods out.				From #7
1:05	40.9	CRITICAL #1 Rod out				From #6
		#2 Rod 1 cm in				

Critical at 40.9 ± .05 cm as sight glass reading
less 6 mm = 40.3 ± .05 as critical ht.

235 B

1:10

	Scale	Comp	Act.
Sep	16.7	—	5
#2 Source	14	59.2	14.0
#2 CR	3.5	63.6	0

Sol'n Ht.	C_1	C_2	c_1/C_1	c_2/C_2
40.9	~~427.5~~	387.5	~~.076~~	
1:35 45.0	762	711	.135	.105
			.058	058

Cylinders moved together
Scale = 13.6
11.7
1.9 cm

1:45 Sep =

Critical height = 44.4 cm (corrected for zero of cyl)

Ex 235C

			actual
Sep	21.7		~~10~~ cm
#2 Source	19	56.7	14
#2 CR	3.5	61.1	0

1:52 47.2 #6 MT from 5

moved together to 16.5
11.7
4.8 cm

2:00 50.1 cm

Critical at 495 ± .05 cm of separation of 4.8 cm

2:05 501
54.5
2:15 55.2
Movi

Sol'n Ht =
Critic

Sol'n Ht
2:22 55.2
2:30 61.6
64.8

2:40 scale

Critic

2:45

Sol'n Ht.
64.8
2:50 69.2

Critical

Ex 235 D

		Comp	actual
Sep	31.7	—	20 cm
#2 Sour	#4	51.7	14
#7 CR	3.5	56.1	0

2:05 50.1 from #5 cyl.
54.5 MT #5
2:15 55.2 from #3 cyl.
moving cylinder together to scale of 19.7 / 11.7 / 8.0
Sol'n Ht = 54.9 - 0.6 zero correction.
Critical at 54.3 ± .05 at 8 cm sep (corrected)

Ex. 235 E

20 cm separation

	Sol'n Ht	Cyl.
2:22	55.2	#3
2:30	61.6	#3 MT
	64.8	#2

2:40 scale 29.8 — 64.8
11.7 — .6 zero correction
16.6 cm separation — 64.2
Critical at ~~64.8~~ 64.2 cm ± .05 at 16.6 cm separation

235 F

2:45

		comp	scale
Sep	46.7	—	35
#2 Source	14.0	~~44~~ 37.2	
#7 CR	3.5	48.6	

Sol'n Ht.	Cyl
64.8	#2
2:50 69.2	#2 MT
	#1

Scale ~~43.0~~ 43.0 Sol. 74.5
~~Ht~~ 11.7 0.6 zero correction
~~26.3~~ 31.3 73.9
Critical at 73.9 cm at ~~26.3~~ 31.3 cm separation

8

235 G

	Scale	Comp	actual
Sep	61.7	—	50
#2 Source	14	36.7	14
#2 CR	3.5	41.1	0

	Sol'n	Cyl.
3:05	74.5	#1
3:10	76.7	#1 MT
		from #7

Scale 55.0 Sol'n HT 80.2

16.7 .6 zero correction

43.3 79.6

Critical at 43.3 cm separation at 79.6 cm sol.
Height was within ~2 cm of CHT in cylinder

A graph of separation vs. height @ criticality was plotted.
The data give a smooth curve (p.v.) but it could not be
determined from inspection of said curve whether or not single
10" cylinder was safe @ ∞ height. It was not believed that
doing a single untamped would given anything other than a
slowly sinking multiplication curve at 80 cm. Usually the separation vs
height curve is as good a criterion of safety of a tall cylinder as
its own multiplication curve.

The slope of the critical height vs separation curve
decreases as separation increases indicating a finite critical
height for a isolated 10" untamped cylinder @ ~ 90 cm.
More can be said when the exact H/X is known.

Solute
A
Anal
3/1/49 Exp 2
IX
Separation
Hc meas
Hc corrected
H/x
Conc
Type
Vc
Mc

2/27/49

Solution drained back by "gamma" method.

All cylinders in pit are full except #1 which has approximately D.V.
All other cylinders are same except "D" which is virtually M.T.

Instruments

Monitor G. - power supply (?)
Trouble with chart drive on #3 & #5
#4 NG. Trigger shorted out. Trouble probably at preamp end of gadget
Counters OK.
#3 OK but still not in trip circuit (also chart drive)
#6 OK

— o —

2/7/49 DC

Exp 235 - 2- 10" ac unstamped.

	A	B 1.9cm	C	D	E	F	G.
Separation	0 cm	~~5.0cm~~	4.8 cm	8.0cm	16.6cm	31.3 cm	43.3 cm
Hc meas	40.3	44.4	49.5	54.3	64.2	73.9	79.6
Hc corrected	40.8	44.9	50.0	54.8	64.7	74.4	80.1
H/x	328.7						
Conc	0.0715 gm x/gm = 0.0787 gm x/cc						
Spec	1.101						
Vc	20.67ℓ	22.75	25.33ℓ	27.76ℓ	32.78ℓ	37.69ℓ	40.58ℓ
Mc	1.63 kg	1.79.	1.99 kg	2.18 kg	2.58 kg	2.97 kg	3.19 kg.

...w corrections

...6 cm sol.

...plotted.

...' not be

...v not Hyde

...ived that

...> than a

...paration vs

...tall cylinder so

...curve

...finite critical

...' 90 cm.

10
7/28/49

EXPERIMENT 236

H/X = 328.7

10" Al Reactors, Tamped

H/X = 320

MACKLIN
PRESSEY
MOONEYHAM
FOX
CALLIHAN

TRIP POINTS, #6 ✱ 5.5 x 100
SCALES - #3 x 100, #4, 80, #5 x 2, #6 x 25

	Scale	Comp	Actual Pos'n
Source #1	5 cm	- cm	0 cm
" #2	0	62.7	0
CR #1	9.0	-	0
CR #2	3.5	65.6	0
Separation	(11.3) ~~13.0~~ 13.1	—	(0) 1.2
#1 Tamper	3.1		~~7.1~~ 7.3
#2 Tamper.			58.8

Exp A. - Single Cylinder #1

~~#2 Cylinder placed at 90 on Indicator.~~

Sep.	70.0	—	58.1	#1 - Empty
#2 S.	~~35~~ 0	33.6	0	?
#2 CR	3.5	36.5	0	

#1 Source 13 — 8
#2 " OUT
4.0 cm ~~sol.~~ left in #2 Cylinder

		C_1	C_2	C_0/C_1	C_0/C_2	
10:25	9.0 cm.	14.0 (14.0)	~~8.5~~ (9.0)			
		13.5	9.5			
10:35	14.05	22.0	15.0	.637	60	#2 Empty @ 14.0
						Feeding #3
	17.5	37.0	28.0	.378	.323	
10.50	20.05	90.0	75.0	.155	.120	
10:59	21.45	Slightly sub-Critical				
11 04	21.65	Critical with Rod up 1 cm				

Conclusion: Critical at 21.5 ± .05

Opened Valve between Reactors 1 & 2
Drained into #3 to equalize at ≈ 10 cm.

11 25
11 35
11 50
12 03
12 13
1 09 PM
1 30
1 44
1 56

Part B

2-10" AL Reactors in contact Tamped

#1 source at 6.0 cm (Act) #2 source at 6.0 (act.)

← CR's Sep. etc.

		C_1	C_2	C_0/C_1	C_0/C_2
1135	10.15	(19.5)	(15.0)		
1136	12.9	30.0	25.0	.65	.60
1130	15.15	70.5	72.0	.278	.209
1203	16.05	234.5	250.6	.083	.060
1212	16.5	Critical	} #1 Rod out #2 " 12.5 cm up		
	16.45	Slightly Super-critical with Rods out			

Conclusion: Critical at 16.4 ± .05

Part C

	scale	comp.	actual
#1 source	11	6.0	6.0
#2 "	6	61.2	6.0
#1 CR	9.0	—	0
#2 CR	0	64.2	0
Separation	14.9	—	3.0
~~#1 Tamper~~			
~~#2 Tamper~~			

		C_1	C_2	C_0/C_1	C_0/C_2
109 PM	16.4	64.5	61.5		
130	17.5	64 164.5	63.5 171.0	.31 .118	.237 .088
148	18.1	Slightly Sub-critical			
150	18.3	Critical	} #1 in #2 up 12 cm		

Conclusion critical at 18.2 ± .05

Part D 8 cm Separation

	Scale	Comp.	act.
#1 Source	11	—	6
#2 "	6	58.7	6
#1 C.R	8	—	0
#2 C.R.	3.5	41.5	0
Separation	19.9	—	8

	C'	C_2	C_0/C_1	C_0/C_2
18.3	64.5	59.0	.303	.254
19.45	122.6	119.5	.160	.125
20.4	slightly	sub-critical		
20.75	crit.	{ #1 Rod in #2 " up 13.5		

Conclusion: crit. at 20.6

Part E 13 cm separation

	scale	comp.	actual
#1 Source	11	—	6
#2 "	6	56.2	6
#1 C.R	8	—	0
#2 C.R.	3.5	—	0
Sep.	24.9	—	13

Not Part E

Decided not to make a determination at this separation

Drumback #5 to 16.4
#3 to Full (Not equilibrate
#2 filled (as measured by δ).
#1 DV +

Solution zero is zero on sight glass checked on drum back

2 - 10" al reactors Tamped.

3/7/49 JC

NB → "A" is single #1 cylinder

	A (SINGLE CYL. #1)	B	C	D
Separation	~~0 cm~~	0 cm	3.0 cm	8.0 cm
He meas	21.5 cm	16.4	18.2 cm	20.6
He cal	22.4	16.9	18.7 cm	21.1

H_R = 328.7

Conc. 0.0715 gm U/gm. = 0.0787 gm U/cc

Sp. Gr. ~~1.8~~ 1.101

Vc	11.35 ℓ	9.56 ℓ	9.47 ℓ	10.69 ℓ
Mc	0.89 kg.	0.67 kg	0.74 kg	0.84 kg.

Tra

Trip point Fuel

6:05P	Filled
6:15P	H = 13.2
= 35	= 20.0
	28.6
:45	= 30.3 ~~30.5~~
7:10	= 38.7
15	~ 45.5
27	~ 49.6
46	= 60.0
~~8:07~~	~~= 63.0~~
8:07	= 62.75
27	= 62.3 ~~62.0~~
32	= 62.0
37	= 61.6
47	= 61.0

A ⇒ Conclu

H/X = 328.7

2/28/49

from

act.

6e
6e
8
0
8

Experiment 237

Two — 6" al Cylinders - Tamped H/x = 320

CRONIN
CALLIHAN

	scale cm	Comp cm	Actual cm.
Separator	1.7 (2.9)	0	0.2 (1.2)
#1 Cl	9.0	—	10
#2 Cl	3.5	70.7	0
#1 Source	~~12.7~~ 5	—	12
#1 V -	Not used		0
#1 Tamper			—
#2 Tamper.	-	-	22.2.

Bottom of #2 cylinder is 1/2" lower than bottom of #1 cylinder - measurements of bottom thickness above #1 = 1.3 cm, #2 = 1.5 cm

Therefor #2 bottom is 1.0 cm lower than #1 bottom.

to each cylinder is added average of these 1.0 cm and the usual bottom correction: $\frac{1.0 + 2.6}{2} = \frac{3.6}{2} = 1.8$ cm

Trip point - same as Exp 236.

Tests OK -

	6.05P	Filled DV-			#1 MT. Fillings from #2	
	6:15P	H = 13.2	C_1 12.5	C_2 7.5		
			12.5	7.5		
	= 35	= 20.0	11.0	8.0 (Source on top of tamper).		
		28.6	—	—	M_1^{-1}	M_2^{-1} & #2 MT, Start #3
	:45	= ~~30.5~~ 30.3	32.0	15.0	~~0.039~~ 0.34	0.50
	7:10	= 38.7	42.0	20.0	0.298	0.375
	15	~ 45.5				#3 MT, From #5
	27	~ 49.6	77.0	33.5	0.174	0.224
	46	= 60.0	263	138	0.048	0.054
	~~8.07~~	~~= 63.0~~				Start from #8
	8.07	= 62.75	CRITICAL WITH #2 rod out & #1 up 20 cm			
	27	= ~~62.0~~ 62.3	" " "		32 "	
	32	= 62.0	. . . . .		30 cm	
	37	= 61.6	. . . . .		46 "	
	47	= 61.0	Sub Critical -			

A Conclusion - Critical at 61.3 ± 0.2 cm - at 0.2 cm separation

Closer approach prohibited by wired bead.

actual

6e
6e
0
0
13

ction at this

1 not equilibrate
by 8).

back

C_1/C_1	C_2/C_2
.303	.254
.160	.128

3/28/49

Callihan
Martitt

Exp 237 (Cont).

2-6" al Tamped Mx 3st Cont-

Separation to ~~5 cm. 5.2 cm~~ 5.0
Indicator to. 6.5
CR Comp. to 70.7 − 2.5 = 68.2

10:00 P [At this point it was found that about 12" of tamper water had leaked out, presumably through the 3" line in the 0.2 cm separation point was checked).

added pol to

10:20 P B = H = 64.4 Sep. scale ~~2.2 cm~~ 1.7 0.5 cm 0.2 ~~actual 3 cm~~

Sep = 0.5 cm actual
scale = 2.2

CRITICAL WITH RODS OUT.

Separation to 3.9 cm

11:15 P C = H = 68.0 cm Sep. Scale = 2.5 cm

Actual separation = 0.8 cm

Critical with all rods out

Further experiments limited by reactor height.

3/7/49 pc. Exp. 237 - 2 - 6" al cylinders tamped

	A	B	C
Separation	0.2 cm	0.5 cm	0.8 cm
He meas	61.3	64.4	68.0
He corr	63.1	66.2	69.8

Mx = 328.7
Conc. = 0.0715 gm x/gm = 0.0787 gm x/cc
ρfg = 1.101

Vc =	11.51 ℓ	12.07 ℓ	12.73 ℓ
Mc =	0.91 kg	0.95 kg	1.00 kg

The
data h
case in

1.

2.

3.

4.

5.

Callihan
Morfitt

3/2/49

Treatment of Data

The following decisions with regard to treatment of the data have been made after individual investigations of each case in point:

1. H/X will be calculated without corrections for impurities (Already shown to be small.) Use formula on p 33 of Summary Book #26.
2. The assay will be taken as 93.4% in all calculations as in the past.
3. In interpreting the results on single cylinders, the height corrections for the 3" end section will be made as in the past, from the table p 31, Summary Book #26. Data for 8" cyl. on p 14 & 26, Exp book #27, indicate that this is probably good within ~~our~~ precision. Data for 10" cyl. on p 72 & 76 Exp book #27 corroborate this.
4. The effect of 3" section on interaction:
   (a) The effect of 3" pipe section on #1 cyl. upon interaction is ~~negligible~~ negligible, as shown by comparison of "corrected" data on experiment 220 & 205. Graphed in "Interaction Graphs" book following multiplication curves, etc. on pg 220.
   (b) ~~One should consider in all cases the total quantity of U235 in system.~~
   (b) In experiments done in normal manner (ie. bottom of both reactors at same level as zero on sight glass) the effective height (to be used in calculating the mass) is for each cylinder:
   Sight glass reading + 1/2 of the appropriate bottom (ie 3 in pipe section) correction. Correct table of values p 33 book #26.
   (c) In experiment 220, where the #2 cylinder was deliberately lowered by the amount of the normal correction, the effective height for each cylinder is
   Sight glass reading + the full 3" pipe correction (~~table~~ p 33 #26).
5. Zero Corrections
   (a) Individual experiment should be carefully examined to make certain that corrections to sight glass readings obtained by closing the zero level are not buried in the data

5. (cont)

~~(b) At this stage of investigation it is believed that "the case" of the 8" & 10" cylinders that the #1 & #2 cylinders in each set are at the same elevation with respect to the sight glass; whereas the #1-20" cylinder was probably cm higher that the #2-20" as shown by the graph plotted for experiment #234 & confirmed by~~

(c) The net result of a rather lengthy investigation into sight glass zeros etc. can be stated as follows.

1. Precision under some condition Sight glass reading good to within 1mm.

2. Accuracy in many cases equivalent to 5 mm. difference in sight glass, because of welded joints, gaskets etc.

Ch

Bes

Material

Total (

per gr

$N_H =$

As the

$\sum \frac{p}{at.}$

Material	ppm	
Ag	0.5	
Al	2000	
As	<10	
Au	<0.1	
B	15	7
Ba	<10	
Be	<0.1	
Bi	<1	
Cd	200	29
Co	20	3
Cr	120	
Cu	500	
Fe	2000	
Ga	<1	
Hg	<10	4.
In	<1	1
Mg	60	
Mn	40	
Mo	<10	
Ni	10,000	
P	<10	
Pb	40	
Sb	<10	
Si	1	n
Sn	20	
Tl	<1	

Ck Calculation of absorption of Neutrons for Soup as of 3-11-49

Material

Based on Lab Report 160 from VG Katzela Group and AECD-2138

Total Cross sections per gram of TO_2F_2 to be computed, or better per gram X.

$N_X = \frac{6.06 \times 10^{23}}{235}$

For fission $N_X \sigma_f = \frac{6.06 \times 10^{23}}{235} \times 550 \times 10^{-24} = 1.42$ cm²

" capture $N_X \sigma_c = \frac{6.06 \times 10^{23}}{235} \times 92 \times 10^{-24} = 0.237$ cm²

$N_H = \left(\frac{H}{X}\right) N_X$ For capture $N_H \sigma_c = \frac{6.06 \times 10^{23}}{235} \times 0.32 \times 10^{-24} \left(\frac{H}{X}\right) = 0.000825 \left(\frac{H}{X}\right)$ cm²

As the lab analyses are based on TO_2F_2 let us first compute

$\sum \frac{\text{ppm of } TO_2F_2}{\text{at. wt.}} \sigma_c$ for the impurity metals using the highest ppm reported.

	ppm	$\sigma_c \times 10^{24}$	at. wt.			$\frac{N\sigma}{gm\ UO_2F_2} \times 10^7$
Ag	0.5	60	107.9	0.28	~~cm²/10⁶ gm UO₂F₂~~ (mol × barns / 10⁶ gm UO_2F_2).	1.7 ~~1.7~~
Al	2000	0.21	27.0	15.56		93.7
As	<10	4.3	75.0	0.57		3.4
Au	<0.1	95	197.2	0.05		0.3
B	15	715	10.8	993.06	14% of Σ	5978.2
Ba	<10	1.3	137.4	0.09		0.5
Be	<0.1	0.01	9.0	0.01		0.1 0.06
Bi	<1	0.015	209	0.00		0
Cd	200	2900	112.4	5160.14	73% of Σ	31064 80
Co	20	36	59	12.20		73.4
Cr	120	2.5	52.0	5.77		34.7
Cu	500	3	63.6	23.58		142.0
Fe	2000	2.5	55.9	89.45		538.5
Ge	<1	2.8	72.6	0.04		0.2
Hg	<10	430	200.6	21.44		129.1
In	<1	194	114.8	1.69		10.2
Mg	60	0.3	24.3	0.74		4.5
Mn	40	13	54.9	9.47		57.0
Mo	<10	2.6	96.0	0.27		1.6
Ni	10,000	4.5	58.7	766.61	11% of Σ	4615.0
P	<10	0.23	31.0	0.07		0.4
Pb	40	0.2	207.2	0.04		0.2
Sb	<10	4.5	121.8	0.37		2.2
Si	1	~0.2	28.1	0.01		0.1
Sn	20	0.55	118.7	0.09		0.5
Tl	<1	3.	204.4	0.01		0.1

V	<10	4.5	51.0	0.88
Zn	300	0.9	65.4	4.13

7106.62 ~~cm²/10⁶ gm UO₂F₂~~ mol barns / 10^6 gm UO_2F_2

10^6 ~~grams~~ of TO_2F_2 corresponds to $\frac{10^6}{305} \times 6.06\times10^{23}$ atoms T

or $0.93\times10^6 \times \frac{6.06\times10^{23}}{305}$ ~~atoms~~ X $= 1.848\times10^{27}$ atoms X

1 gm $TO_2F_2 = 0.93\left(\frac{235}{305}\right)$ gms X $= 0.717$ gms X

∴ Impurity Cross Section per gram X is

$$\frac{7106.62}{0.717} \times10^{-6} \times10^{-24} \times \frac{6.06\times10^{23}}{235} = \frac{0.00601}{0.0000256}\ \frac{cm^2}{gm\ X}$$

Fluorine cross section

$$\frac{2}{0.93} \times \frac{6.06\times10^{23}}{235} \times 6.01\times10^{-24} = 0.00005\overset{56}{3}\ cm^2/gm\ X.$$

Oxygen cross section

$$\left[\frac{2}{0.93}\times\frac{1}{235} + \frac{1}{2}\frac{(H/X)}{235}\right] \times 6.06\times10^{23} \times 0.001\times10^{-24}$$

$$\leq 0.000\overset{56}{1}06 + 0.00000129\left(\frac{H}{X}\right)\ cm^2/gm\ X$$

U_{235} & U_{234} capture should also be significant

From LA-399 we take average $\sigma_{c.(238)} = 2.56$ barns for (dilute) Solution. This may be low at $H/X \approx 25$ & thereabouts. For simplicity we also take $\sigma_c(234) = 2.56$ barns

total cross section per gram X is

$$\frac{.07}{.93} \times \frac{6.06\times10^{23}}{238} \times 2.56\times10^{-24} = 0.00046\ cm^2/gm\ X.$$

221.34
15.51

NO $\times10^7$ / gm UO_2F_2
5.3
5.3
24.9

U_{235} f

H/X = 25	1.42
H/X = 1000	1.42

of 98%

Per gram X (↳ Fission)

H/X = 25	1.42
H/X = 1000	1.42

$\frac{142}{168} = 84.$

$\frac{1.42}{2.48} = 57.3$

Impurit

@ H/X = 25

@ H/X = 1000

See p. 21

These absolute values are in error by ± 0.5% because I used 6.06 instead of 6.02 for Avogadro's number. The effect on relative values is small. DC.

$N\sigma \times 10^7$ / gm UO_2F_2

S3
S3

24.9

mol barns / 10^6 gm UO_2F_2

$\times \frac{6.06 \times 10^{23} \text{ atoms T}}{\text{gm T}}$

$\times 10^{27}$ atoms X / gm X

0.00601
~~0.0000256~~
~~0.00601~~
~~0.0000256~~ $\frac{cm^2}{gm\ X}$

56
~~89~~ $cm^2/gm\ X$.

$9\left(\frac{H}{X}\right)$ $cm^2/gm\ X$

barns for (dilute) Solution
simplicity we also

	U_{235} f	U_{235} & parasitic capture.	$U_{238,4}$ c	H_c	O_c	F_c	$J_m/_c$	
H/X = 25	1.42	0.237	0.000460	0.206	0.00003~~9~~ / ~~0.00004~~	0.000~~0~~56 / ~~0.00089~~	~~0.0000256~~ / ~~0.00601~~ < 0.00601	0.00607
H/X = 1000	1.42	0.237	0.00046	0.825	0.0013 / ~~0.0014~~	0.000~~0~~56 / ~~0.00089~~	~~0.0000256~~ / ~~0.00601~~ < 0.00601	0.00601

$\frac{cm}{gm^-}$

Of the impurities three elements contribute about 98% to the total impurity capture cross section. Cd 73%, B 14%, Ni 11%
(.00439) (.00066)

Per gram X	Fission X sec'd	Unavoidable Capture	Other Impurity Capture	ttl
H/X = 25	1.42 $\frac{cm^2}{gm\ 25}$	0.258	~~0.0000256~~ / ~~0.00601~~ < 0.00601	1.681 + .678
	$\frac{142}{168}$ = 84.5% of absorbed neutrons produce fission.		~~< 0.00601~~ 2.33% = Impurity Capture / Total Capture (non fiss) × 100	
H/X = 1000	1.42	1.064 / 1.064	~~0.0000256~~ / ~~0.00601~~ < 0.00601	2.484
	$\frac{1.42}{2.48}$ = 57.3%		< ~~1.1%~~ 0.59%	

Impurity capture vs Hydrogen capture

@ H/X = 25 $< \frac{.00601}{.206}$ ~~0.124 %~~ = 29%

@ H/X = 1000 $< \frac{.00601}{.825}$ ~~0.003 %~~ = 0.73%

See p. 21

	H/X = 25	H/X = 1000
% neutrons causing fission	41.650 %	41.65 %
% " leaking from core	50.57 ~~50.75~~ %	26.96 ~~27.14~~ %
% " Parasitic capture	7.77 ~~7.57~~ %	31.39 ~~31.21~~ %
% radiative capture by U_{235}	6.95	6.95
" capture by U_{235} + U_{238}	1.3×10^{-2}	1.3×10^{-2}
" " " H	.60	24.20
" " " O	1.1×10^{-3}	3.8×10^{-2}
" " " F	1.6×10^{-3}	1.6×10^{-3}

breakdown of γ: 7.57% (31.21) see p. 21 ...

% neutrons captured by Cd	0.129 %	see p 19	0.129 %	%
" " " B	0.025 %		0.025 %	%
" " " N	0.019 %		0.019 %	%
" " " all others	3.5×10^{-3} % (0.0035 %)		3.5×10^{-3} %	%

Calculations made as follows

Assume ν (per fission = 2.46)

∴ Fraction neutrons absorbed & ~~entirely~~ causing fission

is $\frac{1}{\nu}$ = ~~.4165~~ 0.4065

∴ Fraction of neutrons leaking & undergoing parasitic absorption

$1 - \frac{1}{\nu}$ = ~~.5835~~ 0.5935

Cross-section for fission 1.42 $\frac{cm^2}{gX}$ (see p 19)

Mythical Cross-section for leakage + parasitic absorption + fission

~~$\frac{1.42 \times .5835}{.4165} + 1.42 = 3.409$~~ $\left(\frac{0.5935}{0.4065} \times 1.42\right) + 1.42 = 3.49$

But Parasitic absorption for H/X 25 . ~~0.258~~ 0.264

Mythical

Σ_a Cross-section for leakage = ~~3.409~~ $\overset{3.49}{-}$ ~~.258~~ $\overset{0.264}{-}$ 1.42 = ~~1.724~~ 1.730 ~~1.81~~ 1.79

Likewise for H/X of 1000

Mythical Leakage cross section = ~~3.409~~ $\overset{3.49}{-}$ ~~1.064~~ $\overset{1.070}{-}$ 1.42 = ~~0.98~~ ~~0.919~~ 0.925 1.00

% of absorption are the proportional to the corresponding cross-sections for Fission, leakage, capture without fission. The latter group is the further broken down as shown.

R Marshall
J Wilson
3/25/49
ADC

			$H/x = 25$	$H/x = 1000$
see p 19	0.129	% of all neutrons produced which cause fission =	40.65	40.65
	0.025	% " leaking from core -	51.8	28.7
	0.019	% " parasitically absorbed.	7.6	30.7
	3.5×10^{-4}	% " " by U_{235} -	6.8	6.8
		" " by U_{238} + U_{234}	1.3×10^{-2}	1.3×10^{-2}
		" " by H -	0.59	23.6
		" " O	1.1×10^{-3}	3.7×10^{-2}
		" " F	1.6×10^{-3}	1.6×10^{-3}
		" " Cl	0.126	0.126
		" " B	0.024	0.024
		" " Ni	0.019	0.019
		" " all others	3.5×10^{-3}	3.5×10^{-3}

ing fission

ectic absorption

Es or 6 ric : + fission

1.42) + 1.42 = 3.49

0.264

~~+724~~
~~1.724~~
~~= 1.730~~
~~1.81 +79~~
= 1.42

~~0.98~~
~~0.919~~
0.925
1.00
0
K − 1.42 =

corresponding

ent fission.

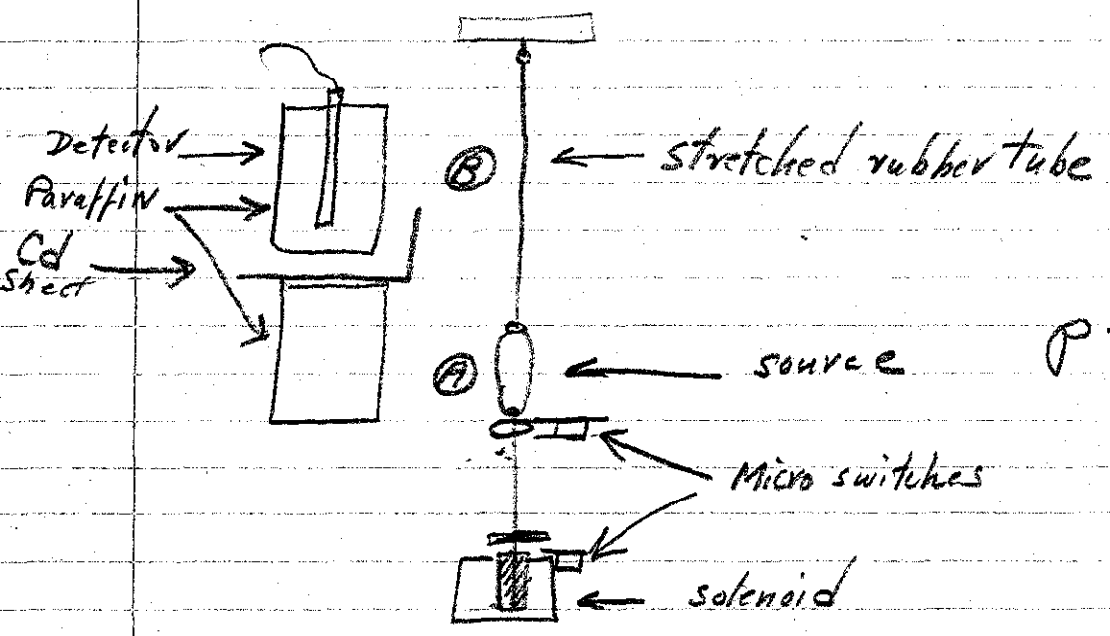
shown.

R Maccia
~~J Mayfield~~
3/20/49
ADC

6/11/49

Measurements of Tripping time

Fox. Oppium



P-26 = measurements

Time for Source to travel from (A) to (B)

Power level as measured on #3 detector
at (A) = 2 on ×100 scale } on Brown
at (B) = 100 on ×100 scale }

at (A) = 0 on ×100 } on milliammeter
at (B) = 42 on ×100 } on #3 Amplifier

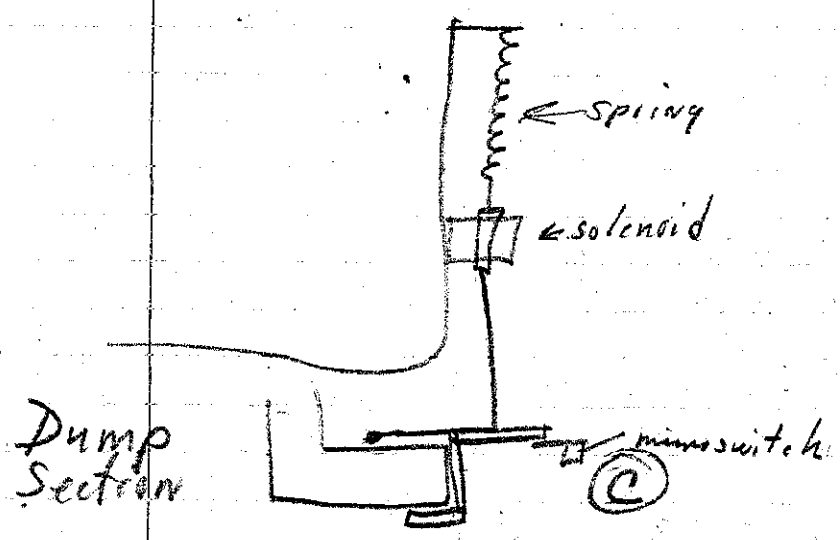
Time in secs

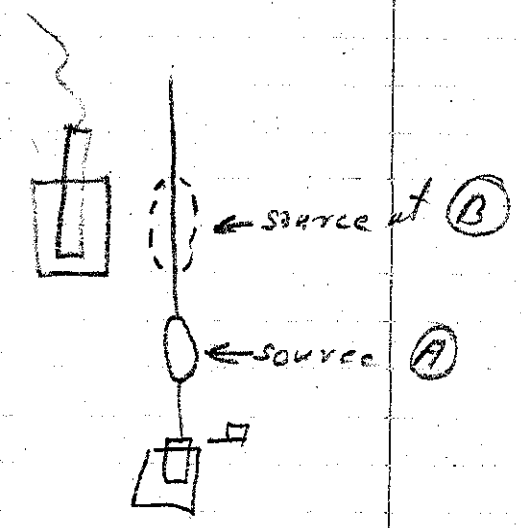
0.17
.16
.17
.17
.17
.17
.17
.17
.17
.17
.16

avg 0.168

Cylinder Equipment setup (Detectors, source, etc

Trip Times (continued)





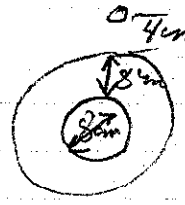
time for source from A & B + time for micro switch at C to open

Trip Pt = 85 on #3 Brown

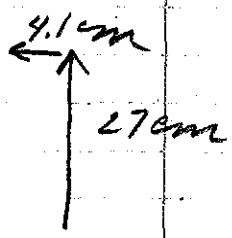
Time in sec's =	3.11	3.13
	3.20	3.06
	3.14	3.19
	3.26	
	3.11	
	3.08	

avg time = 3.14 secs.
− .168
2.972 net

avg time minus time from A & B is time required for safety dumps to open including instrument and relay dead time.



Source travels 27 cm linear to a point 4.1 cm from outer paraffin paraffin is 8 cm thick and diluter chamber is 8 cm in diameter



With using #3 T

With #

with #3 time

With Background 90% of Triggering
using Ra source for additional background

#3 Brown at 76.5

time = 0.83 0.83 secs
0.85 0.87
0.86 0.86
0.86 0.87
0.83 0.90

← source at (B)

← source (A)

avg time 0.856 secs − .168 = 0.688 secs net

With background at 50% of Triggering

#3 Brown at 42.5°

time in secs. 1.55 1.55
1.54 1.57
1.55 1.55
1.57 1.53
1.53 1.52

switch at

#3 Brown

avg time 1.543 − .168 = 1.375

with background at 30% of Triggering

#3 Brown at 24

time in secs 2.04 2.00
2.08 1.99
2.01 1.94
1.93 2.04
1.96 1.98

time

ing instrumento

4.1cm

27cm

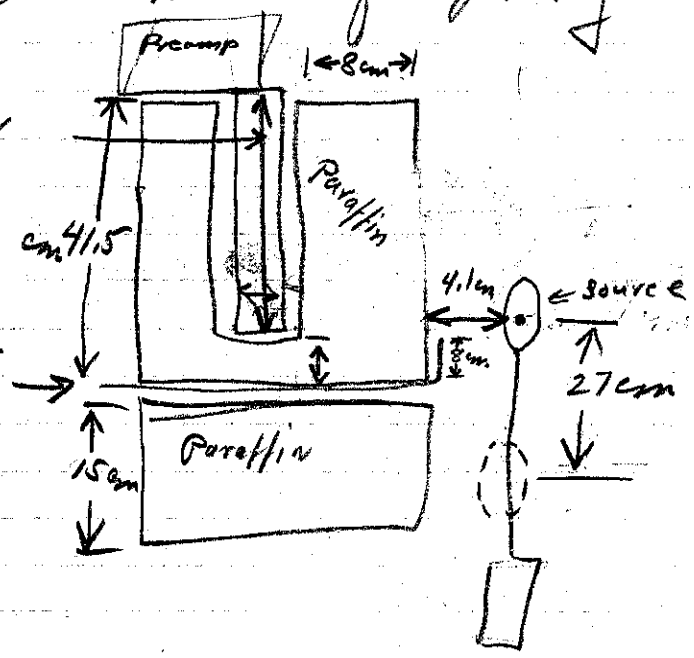
avg time 1.997 secs.
−.168
Net 1.829 secs

5/12/49

Tripping time (cont'd)

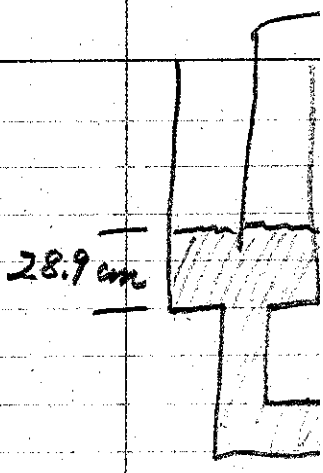
attempted to measure time for dump valve trigger to release but time interval too short to measure.

Motion of trigger is only ½ inch in a straight line and has a 32 #(lb) spring for acceleration. total motion of spring is 1¼ inches.



8cm OD ion chamber 27.5cm long

1/8" Cd sheet



time fo

time

time =

head =

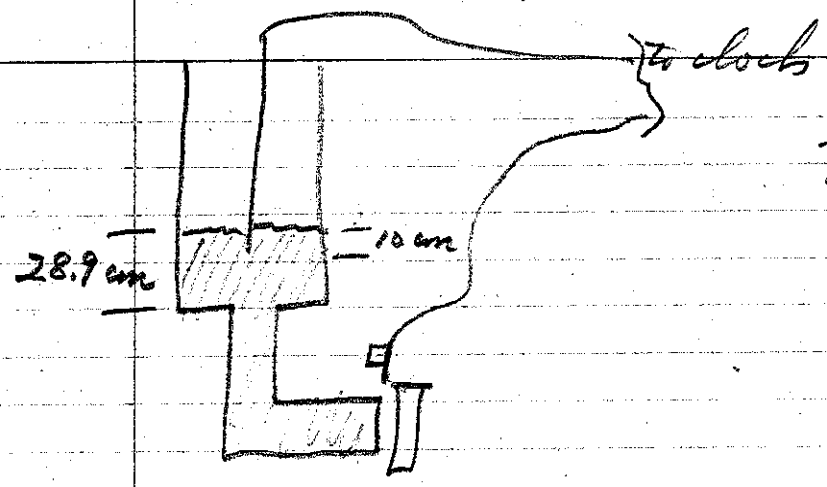
time

head -
time

Mov
head
to move 10cm time

1/2" pipe

5/12/49 Dump time



Fixed Cyl

time for sol'n to fall 10 cm in 5" reactor from time of lifting dump valve trigger. at 28.9 cm on right fork

time = 0.65 secs.

head = 28.9 cm sol'n

time 0.57

head = 28.9 cm sol'n

time 0.94

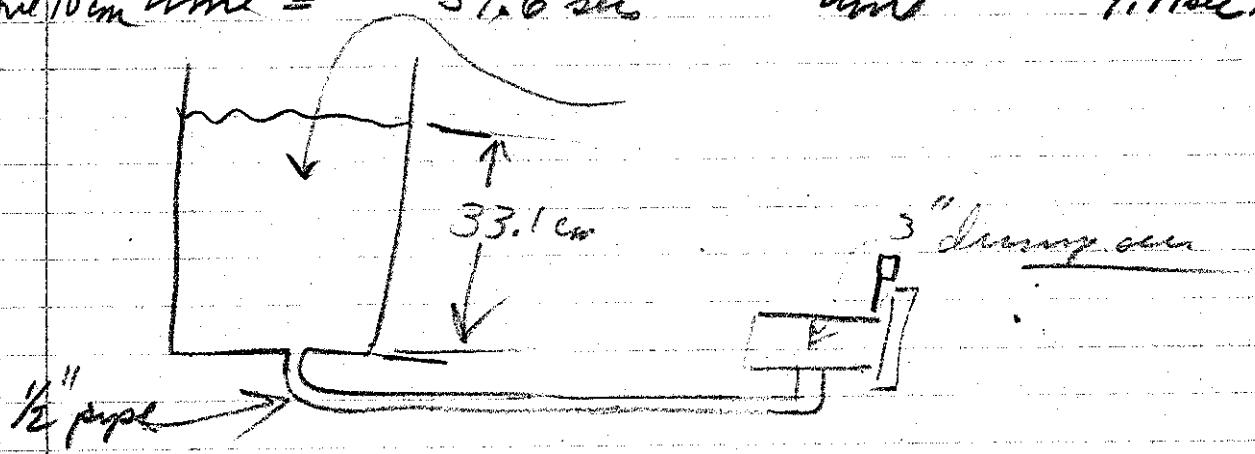
.65
.57
.67
3)1.89
avg .63

head = 28.9
time 0.67

Movable Cyl.

head = 33.1 cm
to move 10 cm time = 39.6 sec

head = 33.2 cm
time 4.7 sec to move 1 cm

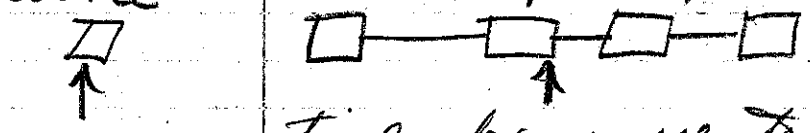


28
5/13

For Cronin

Dump Time Cont.

To measure time from detector to end of DC Amplifier



time for source to reach a point at which detector will trip - (see p. 23-24) until relay in DC amplifier operate (to close alarm circuit)

Using # 4 ion chamber with new pre-amps and new DC amp.

Trip point is 5.8 on 100 scale on output pot same on and 50 scale on micro-ammeter on DC Amp.

Source at same position as with #3 (p. 26) more radiation level to 9 on 50 scale on micro ammeter (off scale on Speedomax recorder)

Trip time	1.30 sec	1.25
	1.25	1.23
	1.26	1.25
	1.32	1.31
	1.31	1.24
avg time =	1.27 secs	1.27

less time for source to move at trip position 0.168

1.102 secs.

of DC Amplifier

This level after source reaches trip position is

NOT the same as before on #3

$\frac{\text{steady level} - \text{trip level}}{\text{trip level}} = \frac{15}{85}$ for #3 = .176

inch

for #4 = $\frac{3.2}{5.8}$ = .552

relay

init)

Changing zero level so that motion of source

pre-amps

carries recorder reading from zero to full scale

is 0-7 trip point at 5.8

Then $\frac{7-5.8}{5.8}$ = .206

B pot

time in secs = 1.46
1.48
1.42
1.46
1.53
5) 7.35
1.47 sec

imp.

(p. 26)

moves

avg
counting time .168
net time 1.302 secs

zero ammeter

with background at 90% of tripping 5.2 on pseudomax

Time in secs .73
.73
.70
.64
.66
5) 3.46
.692 avg

} because of transients caused by switching only about ½ of readings / operated clock half so these readings are only approx.

27

168

1.02 secs.

background at 50% of tripping
(2.9 on Speedomax)

time in sec's 0.86
.79
0,81
.97
.89
5] 4.32
avg .865 secs

} same trouble as at 90% of background

Reconnecting #3 amp as before and measuring from detector to DC amp relay.

time in secs.
2.84
2.99
2.80
2.84
2.93
avg 2.84
less source time .168
2.672
net overall time 2.97
time for relays. .30 secs

Re measurement of overall time to lifting of trigger dumps
2.50 2.73
2.60 2.77
2.65
2.79
2.30
2.70
2.65
2.79
avg = 2.63 secs.

Summary

To measure relative drainage times of cyl #1 with a 3" drain section and cylinder #2 with a ½" drain section. (p. 27)

#1 0.63 secs to drain 10 cm from sat'n ht of 28.9 cm
#2 39.6 secs " " " " " " " " of 33.1 cm

to drain 1 cm =
#1 = 0.06 secs (1/10 of above figure)
#2 = 4.71 secs (measured directly)

The overall reaction time was also measured using a constant time of 0.168 sec to bring the neutron source to tripping distance + about 15%. (page 23)

with background at zero and the trip point at 85 (full scale = 100 when source is at trippt) time required to lift the trigger on the dump valve was 2.97 secs net (subtracting time for source to arrive at trippt.)

Measuring under the same condition from time of source arrival at detector to closing relay at DC amps #3 amplifier was 2.67 secs. which leaves 0.30 secs for mechanical relays operation

Substituting #4 amp (new) for #3. under same or similar condition gives a time of 1.27 secs.

Overall reaction time was also measured using

Conv

varying backgrounds as shown on attached graph. for #3.

From remeasurements of overall time with condition originally giving 2.97 mSec for opening of trigger gave on 2.6 secs

The only conclusions drawn are:

1. most of the time delay is in the instrument circuit negligible time being lost in the relays.

2. ~~Fired~~ cylinders has a damping time ~~of~~ almost 50 times that of the movable cylinder.

note- these measurements all made using ion chambers + DC amplifier #3 + 9

6/14/14

TIME sec

1.0 2.0 3.0 3.6

2.5

3.0

Trigger Time 1.12 secs

Power level (as read on #3 Main Receiver)

Note: Prior to the trigger, the power level was at background level. Upon the trigger, the power level increased to the maximum level.

Trip Point

Reading - Background

toched

on the
eing load

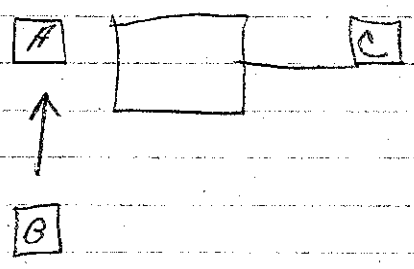
ping time
Cylinder.

ade

-34 9

6/14/49

Vibrating Reed Response time



Time for radium source to move from B to A
and impulse to operate relay at C

With source at A steady state on meter = 8 (full load = 10)
" " " B " " " " " = 0

Trip point at 7.9 on meter
6.95 secs
6.90 "
6.10 "

trip point at 5
2.81
2.75
2.72

trip pt at 5 (background at 2 steady state at 1.0)

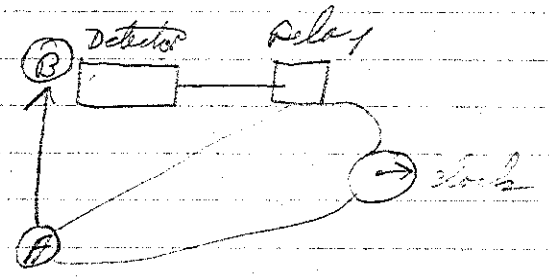
2.09
2.04
2.04

Time for source to go from B to A = 0.25 sec

6/22/49

DL
JKZ
RM
RR

Photo-Multiplier tube (Breadboard set)



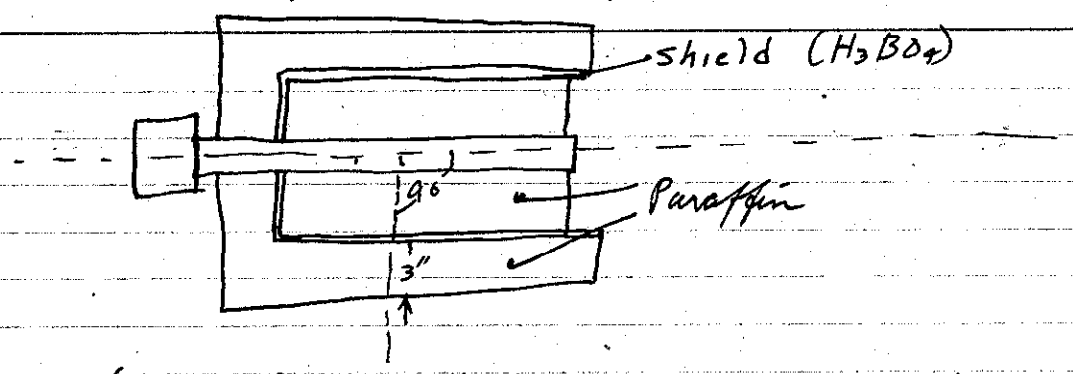
Time for source to go from A to B = 0.17 sec
0.17
0.17
0.17
avg = 0.17 secs.

(Ra)
Using 10 mg Source Trips relay at 2 3/4"

Source 1½" from tube
0.23
0.24
0.24
0.25
avg 0.24 secs
− 0.17
0.07 secs trip time.

Source 2½" from tube
0.35
.37
.36
.35
.36
avg 0.36 secs
.17
0.19 secs trip time.

Tests on Efficiency of Shielded Counter



Position 1: (Axially 24" from center of counter)

32 + 11 counts
30 + 8
} Av 31 counts

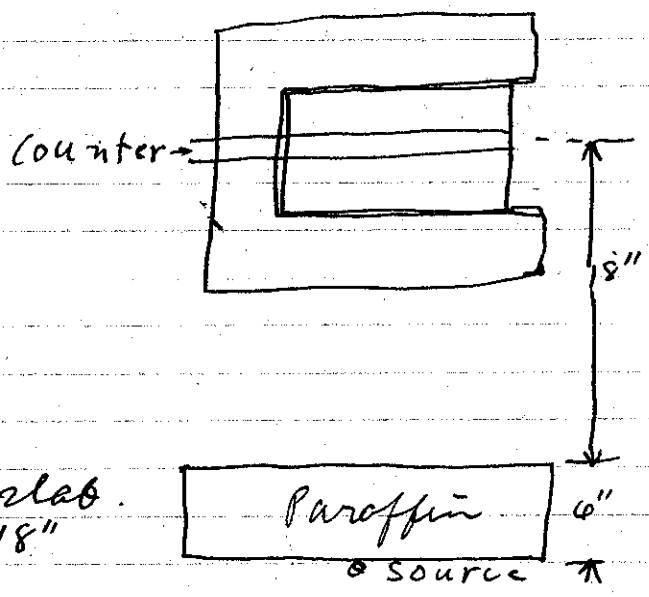
Position 2: (24" at 90° to line of center of counter)

16 + 16
14 + 22
16 + 0
} Av. 15 counts

Position 3: (~~8~~ 30" from center axially back of shield

7 + 0
7 + 8
} 7 counts

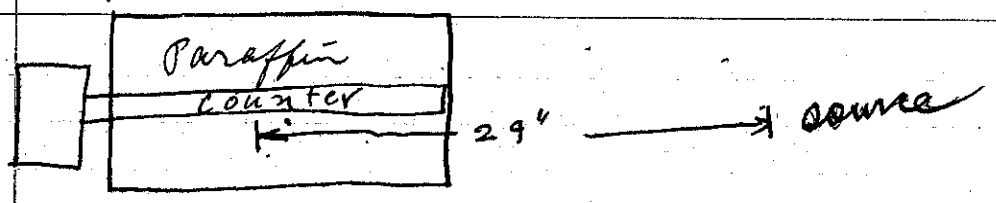
Repeat of position #2 using 6" paraffin in front of source as shown:



7 + 3 counts
7 + 2 "
} Av. 7 cts.

Area of slab.
12" X 18"

6/14/49 Comparisons using old unshielded Paraffin cylinder (same counter as before)



Position 1 (source "29" from center out equally)

32 + 11 } 31 counts Av.
30 + 8 }

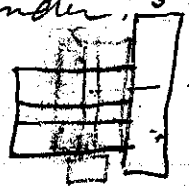
Position 2. (29" at 90° from center of counter to source)

41 + 12 } 41 (Av.) counts
41 + 12 }

Repeat of position 1 except 3" thick slab of paraffin placed between source and counter, 4" from source slab area (12"x18").

23 + 31 } Av. 23 counts
23 + 12 }
23 + 45 }

Repeat of preceding configuration except slab moved up against paraffin cylinder.



26 + 48 } 26.5 counts (Av)
26 + 12 }

Repeat of preceding configuration except slab thickness increased to 16"

14 + 0 } 14 counts
14 + 3 }

Repeat of Preceding configuration except slab thickness increased to 9"

9 + 19 } 9,5 Av. counts
10 + 0 }

6/21/49 Comm for

Position 1

Position 2 (

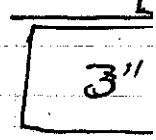
Position 3

Experiment

#1

#2

#3



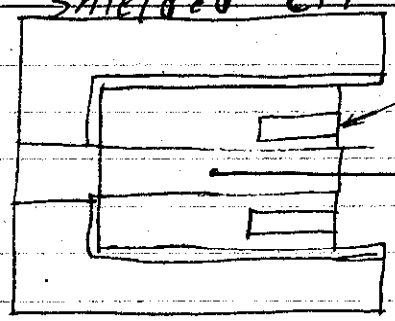
d Paraffin

6/21/49

comm for

comparison continued

shielded ctr



Position 1

counts

29	+	22
29	+	26
29	+	27

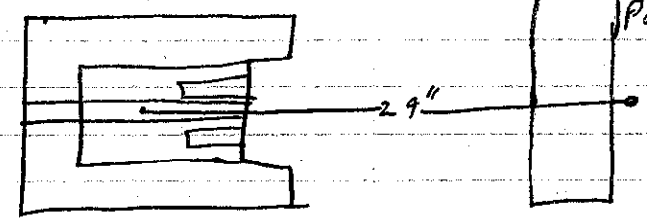
ource)

Position 2 (same except at 90° to chamber)

(counts ×64) - 14 + 43
15 + 4
15 + 11

f paraffin
rom source

Position 3:



lab moved

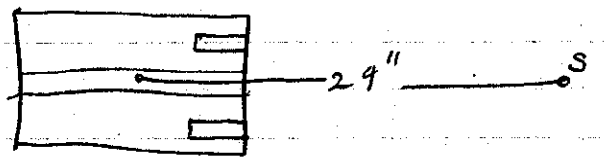
counts ×64

26 + 61
26 + 57

Experiment without Baron Shield:

-- • source

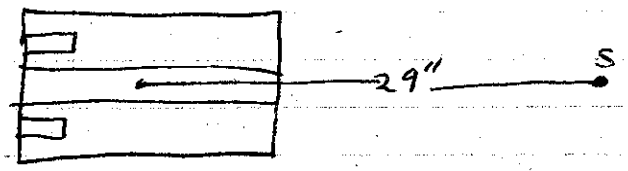
#1



23½ counts

thickness

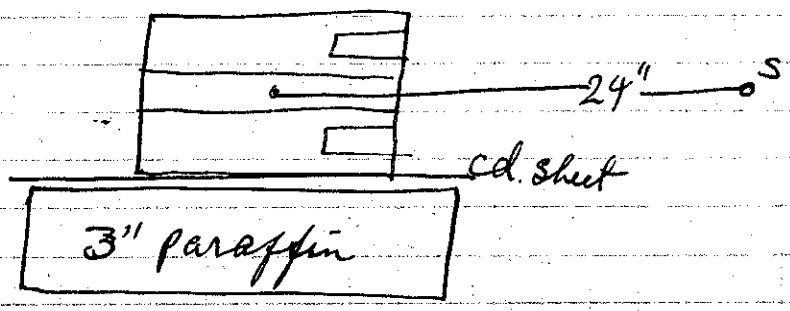
#2



26 counts

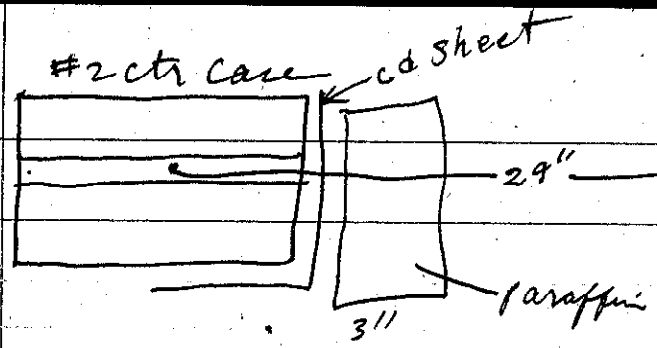
— lab

#3



23 counts

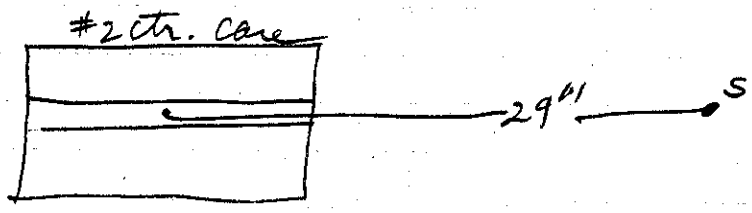
#4



15 ½ counts

#5 same but no cd sheet

18 ¼ counts



#6

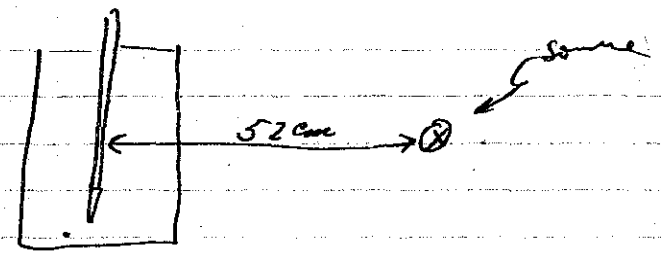
X64
22 + 30
22 + 25
23 + 36
22 + 40
23 + 17

Comparison of BF_3 filled tube and Boron lined tube

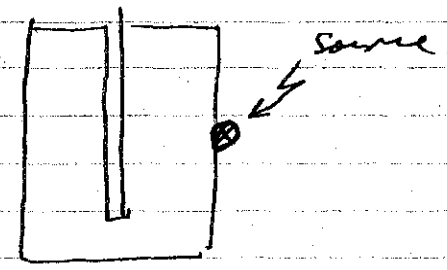
counts

counts

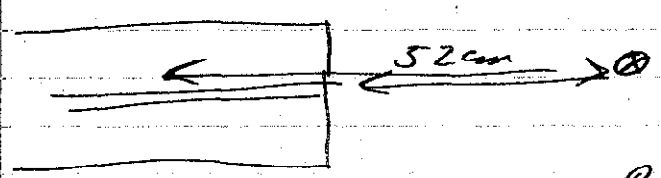
30
25
16
40
17



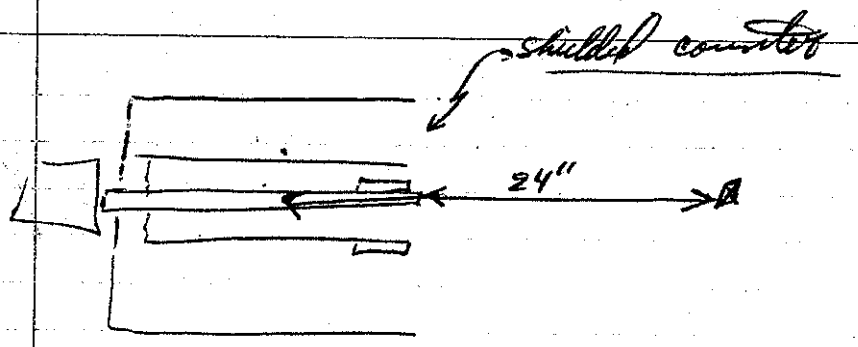
BF_3 tube		boron-lined	
(41 x 64)	+ 23	40 x 64	+ 40
42 x 64	+ 36	41 "	+ 43
40 x 64	+ 31	40 "	+ 16
		40 "	+ 35



BF_3 tube	B lined
597 x 64 + 19	639 x 64 + 7
604 x 64 + 27	643 " + 22
567 x 64 + 31	647 " + 19



BF_3	B lined
+11	34 x 64 + 13
+12	33 " + 25
	35 " + 21



B lined

(×64)

25 +48

26 +2

BF_3 filled

Calculation of H/X for nitrate. (no excess HNO_3)

$$H/X = \frac{2(M_1 - L M_2)}{A L M_3}$$

$$= \frac{2(235 - 391\,L)}{0.933 \times 18\,L}$$

$$= \frac{235 - 391\,L}{8.40L \quad 8.397L}$$

$$= \frac{27.99}{L} - 46.56.$$

where M_1 is molecular weight of X
M_2 " " " $UO_2(NO_3)_2$
M_3 " " " H_2O
L = lab result in gm U/gm sample.
A = assay - (93.3 = ave K-25 as rec'd 7/10/49.
See N.B. # 26 (Summary) pg 33.

Calc. of H/X with free HNO_3 present.:

%U = 24.80 av. analyses
%N = 3.92
%X = 23.15

Mol. wt $UO_2(NO_3)_2$ = 391
" " HNO_3 = 63

wt. $UO_2(NO_3)_2$ = 100 gms = 41.25 gms = $\frac{391}{235} \times 24.8$
wt of N in salt = 2.96 " = $\frac{28}{391} \times 41.25$

Total wt N = 3.92 gms
N in salt = 2.96 "
wt in free HNO_3 .96 "

gms HNO_3/100 gms = $.96 \times \frac{63}{14}$ = 4.32 gms.
gms H in HNO_3 = $\frac{1}{63} \times 4.32$ = .068 gms

gms H_2O/100 gms sol = 100 − 41.25 − 4.32 = 54.43 gms.
" H in H_2O = $54.43 \times \frac{1}{9}$ = 6.05 gms
Total H = 6.05 + .068 = 6.12 gms.

$$H/X = \frac{6.12}{23.15} \frac{235}{1} = 62.1$$

Calc N/X: $\frac{N}{U} = \frac{\text{gms N}/14}{\text{gms U}/235} = \frac{3.92}{14} \frac{235}{24.8} = 2.653$

$$N/X = \frac{2.65}{.933} = 2.84$$

Callihan
Crowin
Fox
Mortell
JM West
(Hanford)

Sour

g/a

G/* U
A
B
D

F

1 38 PM
1 40 PM
2 05 PM
2 12 PM
2 30 PM
2 45 PM
3 02 PM
3 14 PM
3 25 PM
3 32

Hydrogen = 49.2

H_2 = 19.2
V_2 = 7.88
N_2 = 2.83 Kg x

* 8/10/49-

Analyses

$UO_2(NO_3)_2$)

Callihan
Crowin
Fox
Morf.II
JM West
(Hartford)

Experiment #238, 9" Al Reactor, ~~tamped~~ H/X = 63.2 ~~67.6~~

7/22/49.

Source Zero @ 7.0 cm. #6 @ 0.7 meter #3 @ 80 #4 7@200 on meter

Source set a 12.0 cm 5.0 cm off bottom. Using 6" Air.

Control Rod Zero @ 4.0 Set @ 8 cm.

*Must add 1.2 cm. To all Readings because sight glass zero is −1.2 cm.

weight of X
" $UO_2(NO_3)_2$
" H_2O
in gm U/gm Sample.
93.3 = ave K-25 co read 7/22/49.
Cumming) My 33.

Solution Inventory.

Gl*	Value*	vol (l)	C gU/cc	Approx. Capacity in 9" eq'l
A	1	6.5	1.57	∞ D.V + 8 cm
B	4	6.0	1.54	15 cm.
D	2	6.7	1.52	16. cm

	Hgt.	C_1	C_2	$1/M_1$	$1/M_2$	Remarks.
1:39 PM	Filling from Position #1					#1 MT @ 6.7
1:50 PM	#4	30.0 (29.5) use	10.0, 11.0 (10.5) use	1.0	1.0	From #4
2:05 PM	9.9	40.	14.5	.74	.72	
2:12 PM	13.0	66	29.5	.447	.36	
2:20 PM	14.8	126	60.	.23	.175	
2:45 PM	15.8	220.5	114.5	.134	.092	
3:02 PM	16.25	400	204	.074	.052	Est crit. 16.9
3:14 PM	16.6	Not Critical	∞ 30/100	—		Est crit 16.9
3:28* PM	16.85	Critical with CR @ 18.0 cm.				
		Drain ~ 1 min.				
3:32	16.7	Subcritical with CR out.				

Conclusion: Critical @ scale reading of 16.8 cm 16.8 ~~1.6~~
Zero correction 1.2* 1.8
Bottom correction 1.2 1.2 *
Total corr. ht. 19.2 cm Hc ~~19.5~~ 19.65 cm

~~Weight gram~~

54.43 gm.

H_c = ~~19.2~~
V_c = ~~7.88~~ Vc = 8.00 l. 8.08
M_c = ~~2.83~~ kg x Mc = ~~2.86~~ 2.90 kg
H/X 61.8

Drainback into original contr. See above inventory.

*8/10/49- At the conclusion of Exp 240, untamped, the sight glass zero was redetermined as 1.5 cm, a value believed more accurate than that given above.

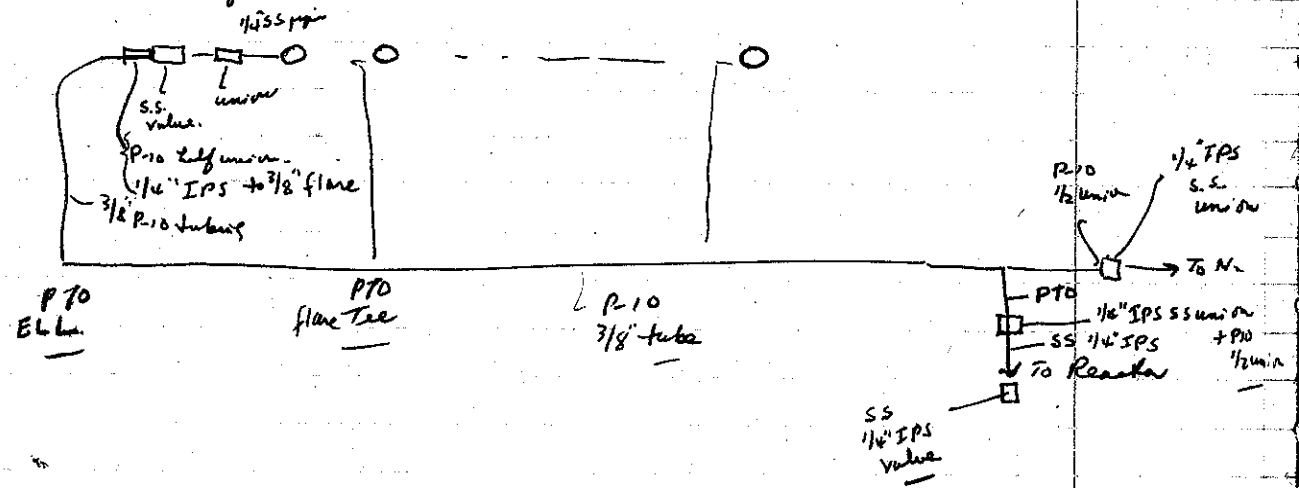
Analyses on Sample Reg 830005 } show 0.2451 gm U/gm ≡ H/X = ~~67.6~~ 67.6 { neglects free HNO_3
" " " " 830006 } " 0.0392 gm N/gm; $\frac{N}{U} = \frac{0.0392}{14} / \frac{0.2451}{235} = 2.68$
or N/X = 2.9

7/22/49 to 8/8/49 inc.

9"

During exp't 238 some leaks developed in the solution manifold in the pit with resultant contamination. Considerable effort was expended in the following ways:

1) Decontamination of pit.
2) Decontamination of cylinders (storage)
3) Transfer of cylinders to Vault 8A for weighing + return.
4) Sampling of cylinders which with 3) allowed a physical inventory to be made by Coted chem.
5) Several unsuccessful attempts to repair threaded stainless steel pipe joints in manifold, yielding more contamination.
6) Discovery of a leaking weld joint in Cylinder B necessitating the transfer of solution from it to K
7) Dismantling of stainless steel solution manifold and its replacement with one of P-10.



Zero:
0

Solution

TRIP PO
INSTRUM

12:55P Started
1:05 H=5.4 cm.

=6.2
1:15 =8.0
1:25 =12.2

8/8/49

EXPERIMENT #239

Fox
CRONIN
CALLIHAN

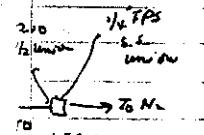
9" AL REACTOR - TAMPED, H/X = ~~7.0~~ = ~~6.80~~ 6.32

Stainless steel top tamper, used in earlier experiments, showing 1" holes for safety rod and sources.
Purpose: to see if unexpectedly large critical mass in Exp. 238 was due to neutron leakage around ill fitting Al tamper and/or through ~~source~~ third (control rod) 1" hole Vertically through top tamper.

Zero: Source 8 cm — set 5 cm from bottom (table = 13 cm).
" # Control Rod 3 cm / in reflector water.
Sight Glass -1.2 cm - add to readings.

Solution Cylinder Position	Cylinder	cm in 9" reactor
1	A	DV + ~ 7 cm
2	K	~ 14 cm
3	C	~ 0.4 cm
4	D	~ 15 cm
5	E	
6	F	
7	G	
8	H	
9	J	

Analyses A 93.00 gU/l 0.245-1
K (from A) 92.5 gU/l 0.243-2
→ 0.244 gU/gm
= H/X = 6.80
gU/l = .22798 gU/cc



TRIP POINTS: #3 - out; #4 = 5.8 x 200 (meter), #6 (Rm 1): 4.5 x 1000, #7 (Photomult). N.G.
INSTRUMENT SCALES: #3 x ~~8~~ 10; #4 x ~~200~~ 100; #5 x 2; #6 x 25 ∑#1 Counts in A alcove - pumping water.

		#1	#2		
Counts:		20.0	7.0		
		18.0	7.0		
		17.0	7.5		
12:55P	Started filling dead volume from #1.				
1:05	H = 5.4 cm.	23.5	13.0		
		20.5	13.5		
		7/4	13.0		
	= 6.2			N-1	#1 Empty. Filling from #2.
1:15	= 8.0	29.5	19.5	0.80	0.67
1:25	= 12.2	52.0	34.5	0.47	0.38

(cont)

Exp 239 - Cont.

		2V I	1/3 II	N^{-1} I	N^{-1} II
1:40P	H = 14.5 cm	102.0	64.5	0.22	0.20
:55	= 16.1	302.5	238	0.07	0.05
2:05	= 16.5+	NOT CRITICAL			
20	= 16.8	CRITICAL WITH 2.8 cm Control rod below safe level.			

CRITICAL WITH H = 16.8 - cm - Sight glass reading

DRAIN BACK INTO #2 - to 6.2 cm.

3:17P
:20 Removed and welded top temps.

:35
:45 Measured height = 16.8 cm at critical.
1.65 cm sight glass zero
1.2 cm bottom connector
~~19.5 cm~~ effective critical height.

4:00
4:15 CRITICAL HEIGHT = 19.65 cm
VOLUME = ~~8.00 L~~ ✓
MASS = 3.08 Kg. U = ~~2.88 kg~~ x
H/X 61.8

8/9/49

Exp 240

9" Al Reactor Untamped.

H/X ≃ ~~70~~ - ~~680~~ ~~680~~ H/X = ~~663~~ 632

Fox
Cronin
Callihan.

Zero's: Source 8 cm
Control rod (in sol) 3.6 cm. (Control Room Temp = 36°C
Safety Rod 10.5 cm
Valve in main sol line 1/4 turn open.
TRIP POINTS SAME AS 239
Source 9 cm from bottom of reactor
INSTRUMENT SCALES: #3 x10, #4 x 100, #5 x 5, #6 x 25, #7 NS.

3:17P	H = 6.5	Start adding out. from #2.				
:20	= 10.0	I 24.0	II 21.0			
		25.5	22.0	I	II	
		~~24.7~~	21.5			
:35	= 15.1	38.5	41.5	0.64	0.52	
:45	= 20.6	51.0	62.0	0.48	0.35	#2 Empty, Filling from 3
	= 20.7					#3 Empty, Filling from #4
	= ~~28.0~~ 28.8					~~#4~~
4:00		76.5	91.0	0.32	0.24	
4:15	= 36.0	94.0	107.0	0.26	0.20	#4 Empty.

Not critical with available U-235.
Probably ∞ safe D.

Inventory- Cylinder A: 15 cm in 9" reactor
K: 15" " "
C: 6" " " plus Dr

Checked sight glass zero on drain back.:
Sight glass readings are 1.60 ± 0.05 cm too low; i.e. add 1.6 cm to all sight glass readings of Exp 239 & 240.
After sight glass line and 3° dump section were emptied they were ~~and~~ refilled to reach the sight glass zero. This was done to eliminate errors due to density inhomogeneities. The value now obtained is 1.5+ cm.

9/19/49: above corrections probably determined without temper water, = correction for temper exp = 1.65a see pg. 77

Specific gravity = 1.547.

Sample 80012 0.2481 gm U / gm sol
80013 0.2480 " " "
H/X = 663 - .3581 gm/cc

54
Cross
For
Morfitt

8/10/45

Experiment # 241 15" Aluminum Untamped H/X = ~~6.3~~ 6.2 ~~6.0~~

Zero on Source 8 cm. Set @ 13 cm 5 cm from bottom of reactor

Trip Points: 5.6 on 200 of #4, 0.8 on Meter of Read.

Soln @ grill (0), when soln in sight glass low by 0.5 cm.
Must Add 0.5 cm to all readings.

#5 on 2 scale #4 on 10 scale #3 on 100 scale Others (OK)

	H	#1	#2	1/M.	1/M.	Remarks	
2:40 ρ	0.0					DV from #2	
2:45	5.2	(17.5, 18.0 21.0, 21.0				Filling from #3, 3 MT	
2:55	6.7					Filling from #2	
2:58	~~7.4~~ 8.2*					#2 MT Blow back	9:40 K
	* Blow back 6 turns New reading 7.4 No leaks anywhere						50
	Symptoms of water in sight glass line.						55
3:17	8.9½	31.0, 29.	31.0, 33.	.58, .60	.65, .6[illegible]		
3:20	10.5	36.0	41.0	.50	.51	Filling from #1	10:05
3:30	11.5	44.	49.5	.40	.42		15
3:40	12.7	52.	61.	.34	.34	#1 M.T.	25
							35
							50
							53

Soln. Inventory from drum base

5 cm in #1 (in terms 15" cyl)
5.2 cm in #2 "
2.7" + DV " (#3-

Check of zero of sight glass after experiment - 0.5 cm again

Critical Height uncertain Probably lies between 18 & ?

Critical H > 18 cm
" V2 > 21 ℓ
" mass > 7.5 kg.
H/X = 6.1?

8/10/49

F = ~~63.3~~ 62.1 ~~63.0~~

Mass of reactor

EXPERIMENT #242. 8/11/49

Fox

Cronin Moffatt Callihan.

15" Al reactor - Tamped. Hx ~~71~~ ~~63.3~~ 62.1

TRIP POINTS: #6 - 7 x 1000 ; #4 - 56 x 200 - #7 out.

INSTRUMENT SCALES: #3 x 10; #4 x 100; #5 x 2; #6 x 25 - #7 out.

~~Zero~~ -

Zero : Source : 8 cm

= C.R. : 3 cm -

58 x 30

#2

#3, 3HT

#2

Blow back.

Source set at 11 cm on scale; i.e 3 cm above bottom.

9:40 Filling DV from #3C

#3 Empty; Filling from #2(K)

		I	II		
50	H = 2.1 cm				
55	= 4.0 cm	30.5	17.5		
		31.5	17.0	m^{-1}	
	→	31.0	17.0	I	II
10:05	= 6.0	48.0	32.0	0.65	0.53
15	= 7.2.	72.0	58.5	0.43	0.29
25	= 8.0	150	154	0.21	0.11
35	8.3	304	338	0.10	0.050

#2 Empty; Filling from #1A

50 = 8.6 CRITICAL WITH CONTROL ROD IN and TAMPER 3mm above Sol.

53 = 8.5 Very slightly subcritical with rod out. —

Sight glass reading at critical = 8.5 cm.

Sight glass zero 0.5 cm.

Bottom correction 0.4

Corrected critical height 9.4 cm.

Drainback.

5 cm in #1 from 15" c. 17.5 cm in 8" reactor

5.2 cm in #2 18 cm - 17

2.1 cm + DV in #3 DV + 7 cm (wait "year")

— o —

H_c = 9.4 cm

A_{eff} = 1.547.

V_c = 10.72 10.72

M_c = (4.12 kg) 3.84 kg. x 3.85

H/x = 61.8

56

8/11/49

EXPERIMENT 243

Moffitt
Fry
Callihan

8" Al Reactor Tamped H/X ~~= 70.~~ = ~~65.3~~ 61.1

Top tamper fits cylinder poorly + has three 1" holes.

Instruments: #3 x10 #4 x100 #4√ x2 #6 x25.

Trip points: #6 - 7 x10 ; #4 √6 x 200

Somm set at 15 cm on scale, 7 cm above bottom - (2 cm = 8 cm).
Zero on control rod = 3 cm.

4:30P Filling from # 3

Fills to observed 10.2 cm; blow back - 9.6 cm; blow back 9.5 cm - 1:50P

		I	II		
4:50	H = 9.5 cm	23.5	~~19.0~~ 19.5		2:03
		22.0	19.5		
		22.7	19.5		
:54	= 10.5			#3 empty; #2 filling	
5:00	= 13.9 ; blow back → 13.8 , blow back → 13.8				
:05	= 13.8 cm	35.0	31.5	0.65	0.62	2:20
:12	= 17.5 ; blow back → 17.4 → 17.4					35
:15	= 17.4	47.5	51.0	0.48	0.38	45
		47.5	52.0	0.48	0.38	53
:27	= 20.0 blow back → 20.0					3:00
:29	= 20.0	68.0	81.0	0.33	0.24	10
:40	= 22.5	168.5	237.5	0.13	0.08	18
:50	= 23.2	300.5	430.5	0.08	0.05	23
:58	= 23.6 NOT CRITICAL.					
6:09	= 23.9 NOT QUITE CRITICAL					
:13	= 24.1 - CRITICAL WITH CONTROL ROD 4 cm BELOW SURFACE					

AT CRITICAL SIGHT GLASS = 24.05 cm
BOTTOM CORR = 1.45
SIGHT GLASS ZERO- ~~0.2~~ 0.1
CRITICAL HEIGHT 25.6 cm

H_c = 25.6 cm
V_c = 8.30 ✓
M_c = 8.30 x 1.547 x 0.248 = ~~3.42 kg~~ 2.98 kg
M_c = ~~2.97~~ 2.98 kg x

Inventory: #1 17.5 cm in 8" reactor
#2 18 cm " 8" "
#3 10.4- + " 8" " + DY.
H/X ~~61.8~~ 61.8

b) 50 4:50 4:00
c) 20

EXPERIMENT 244

8/14/49

Fox Callahan

8" Al reactor Mx ~~70~~ 62.1, Tamped.

a) Top tamper fits better than that used in 243 and has only two 1" holes open (third has polyethylene plug).

TRIP POINTS, #4 5 x 200 (max), #6 – 5.5 x 100.

INSTRUMENT SCALES - #3 x10, #4 x100 #5 x5, #6 x 25

Source set at 15 cm on scale; Zero = 8 cm.

Control Rod Zero = ~~3~~ 5 cm

1:50 P	Filling from #3.		~~#3~~		
	H = 5 cm		#3 Empty	Filling from #2	
2:03	= 8.7 cm, Blow back = 8.7	I	II		
	H ~ 8.7	21.0	13.0		
		23.5	14.5		
		25.0	13.5		
		22.8	13.8	M I	M II
2:20	= 15.1	36.5	20.0	0.63	0.~~89~~
35	= 18.0	46.0	30.0	0.5	0.46
45	= 20.0	66.0	47.0	0.35	0.29
53	= 22.0	134.0	101.0	0.17	0.14
3:00	= 23.0	222.5	174.5	0.10	0.08
10	= 23.7	NOT CRITICAL.			
18	= 23.9	NOT QUITE CRITICAL			
23	= 24.0	CRITICAL WITH CONTROL ROD 10cm BELOW SOL. LEVEL.			

(10cm of control rod ∠ 1mm Dilution).

SIGHT GLASS AT CRITICAL 23.95 cm

BOTTOM CORRECTION 1.45

SIGHT GLASS ZERO 0.1

CRITICAL HEIGHT 25.5 cm.

$V_c = 8.27$ $M_c = 2.962.97$ H/X 6.68

b) REMOVED POLYETHYLENE PLUG FROM 1" HOLE IN TAMPER.

50	= 24.0	CRITICAL WITH CONTROL ROD 5cm for BELOW SOL. LEVEL
~~4:10~~		
4:00	= 24.3	NOT CRITICAL WITH TAMPER 8 mm above sol + control rod out
c) 20	= 25.7	CRITICAL WITH TAMPER at ~~33.9~~ 34.0 cc 8.3 cm above sol + control rod 2 cm above sol

SURFACE

Cont.

8/12/49 Exp. 244 Cont.

		I	II	m^{-1} I	II	
4:30P	H = 25.7 cm	264	244	0.09	0.06	Tamper at top of reactor i.e 45 cm from solution level Filling from #1 from R.V.
:40	= 26.1	460		0.05	0.03	
8). 45	= 26.6					

→ CRITICAL WITH CONTROL ROD 5cm BELOW SOLUTION; TOP TAMPER 45 cm above solution surface.

INVENTORY: #1 19cm in 8" reactor
#2 16.9 " " " "
#3 10 " " " " + D.V.

① With 8" reactor + Htr. ~~68~~ 66.3 the critical mass volume is not measurably affected by the presence of a third 1" hole in top tamper + its poor fit into reactor (243 vs 244a).

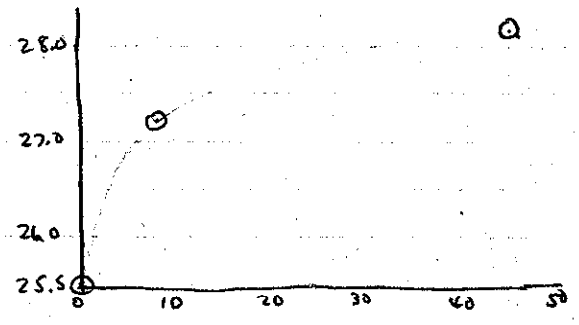
② ① is checked by noting removal of polyethylene plug from 3rd hole in top tamper increases critical height by less than 0.5 mm. -234b

③ Effect of top tamper on critical height:

Top tamper in Contact with solution. H_c = 25.5 cm

" " 8.3 cm above solution surface $H_c = 25.7 + 1.45 + 0.1 = \overset{27.3}{\cancel{26.4}}$ cm

" " 45 " " " $H_c = 26.6 + 1.45 + 0.1 = 28.2$ cm.



12:45	Filling
58	H = 10.5
1:01	= ~~13.8~~ 13.7
12	= 18.0
1:23	= 27.3
34	= 32.4
45	= 40.0
:51	46.0

8

Mtg

Instrum

TRIP

Source

C.R.-

Count

little

Heigh

8/15/49

EXPERIMENT 245-

CRONIN
FOX
CALLIHAN.

8" AL UNTAMPED Hk ~~= 70 = 66.3~~ 62.1

To serve as reference for those subsequent experiments with stainless steel tamper.

top of reactor
from solution level
" from 2V.7

ER

Instrument Scale: #3×10 #4×100 #5×2 #6×25

TRIP PTS - #4 - 5.8×20; #6 - 6×1000 #2

Source rods at 20" on Rods - 12cm above bottom
C.R. - Zero = 8.5cm.

	12:45	Filling from #3 -				
	58	H= 10.5cm	#3 Empty	Filling from #2 -		
nal measurements & ds	1:01	~~= 13.8~~ 13.7	I 41.0	II 42.5		
			41.5	42.5		
		→	41.3	42.5	I	II
3" Rule in mm. -234b	12	=18.0	51.5	57.0	0.80	0.75
	1:23	=27.3	62.	92.5	0.66	0.46
27.3 cm = 26.4			64.5	94.5	0.64	0.45
= 28.2 cm.	34	=32.4	~~70.5~~ 70.0	90.5	0.59	0.47
			77.0	85.0	0.54	0.50
	45	=40.0	81.5	100.0	0.51	0.43
			83.0	100.0		
	51	46.0	82.0	108.5	.504	0.391
			83.0	104.		

2 Empty; filling from #1.

#1 EMPTY.

Inventory - #1 - 18cm in 8" reactor
2 - 18 " " "
3 - 10 " " " +DV.

Counters erratic & low reactivity make data probably of little value in future comparisons.
Height limited by available solution -

8/16/49 — Ex 246

CRONIN FOR CALLIHAN.

8" Al Untamped with 3" of Stainless H/X ~~70 60.3~~ 62.1

Trip pts

Instrument scales - 3 × 10 — 4 - 5.8 on × 200

4 × 100 — 6 7 on × 1000

5 × 2

6 × 25

Source at 20 cm on scale

CR zero at 8.5 cm

11:15 A. Red Light On.

20 Filling from #3

25 H = 9.8 cm #3 Empty, filling from #2

27 = 14.4

	I	II			
	80.0	64.0			
	64.0	58.5			
	60.0	63.0			
	52.5	52.5			
	60.5	59.7	$\bar{x}$	$M_{\frac{1}{2}}$	
38 = 18.1	96.5	85.5	0.63	0.70	Apparent K of activity increasing on #6
50 = 22.1	172.0	144	0.35	0.42	is conspicuously low!
12:00 = 24.9	215.5	224.0	0.29	0.27	
	173.5	222.0	0.35	0.27	
	165.5	226.5	0.37	0.26	Stopped filling from #2. Fillings from #1
121 = 27.1	275.0	346.5	0.22	0.17	
123 = 29.0	439.5	637.5	0.14	0.09	
129 = 30.1	Not Critical - Rod out.				
132 = 30.2	" " "				
137 = 30.55	" " "				
141 = 31.15	" " "				
147 = 31.75	C.R at 35 on scale CRITICAL with 5 1/4 cm CR below det. surface				
= 31.7	— corrected for C.R displacement				
151 = 31.6	Slightly Sub critical with Rod out.				

INVENTORY - #1 - 18 cm in 8" reactor

#2 - 18 " " "

#3 - 10 " " " + DV.

CRITICAL WITH SIGHT GLASS = 31.6 cm.

Zero correction = 0.1 cm.

Bottom correction = 1.5

CRITICAL HEIGHT 33.2 cm

" VOLUME 10.76 l. ✓ ~~3.55~~ ✓

" MASS. 4.14 kg. ~~3.86~~ kg. x 3.81 lb. H/X 61.8

8/16/49

For Cronin Callihan

Experiment 247.

3 62.1

8" Al Reactor surrounded by 3½" - 347 S. Steel shell — H/X = ~~62.1~~ 62.1 No H_2O reflector

Dust Blades #1 3×10; #4 4×100; #5 2×2, #6 2×25 —

Trip pts + Zeros - Same as 246

3:05	Filling dead volume from #3.					
10	H=9.8	#3 empty filling from #2 to 14 cm.				
12	=14.1 cm.	43.5	61.5			
		39.5	60.0			
		40.0				
		41.0	57.0			
		41.0	59.5	I	$\frac{M+1}{M}$	
23	=18.2	59.5	96.5	0.69	0.62	
		61.0	93.5	0.67	0.64	
30	= 22.3	99.0	187.5	0.41	0.32	
42	= 26.9	261.5	485.0	0.16	0.12	Stop filling from #2; filling from #1
53	=29.4	1127.5	970.5	-0.036	0.064	

4 or #6

5.1

4:04 — 30.4 CRITICAL WITH CONTROL ROD 11 cm below surface

30.3 corrected for control rod displacement

10 — 30.2 CRITICAL WITH CONTROL ROD 7 cm below surface

30.3 - Corrected for C.R. displacement.

Fillings from #1

12 = 30.1 CRITICAL WITH 5 cm control rod below surface.

15 = 30.0 " " 3 " " " "

17 = 29.8 Sub critical with rod out.

CRITICAL HEIGHT - sight glass = 29.9 cm

Bot. surface

Inventory: 18 cm in 8" reactor as #1

18 " " " " " #2

DV + 9.8 " " " " - ~~#4~~ 3

SIGHT GLASS	29.9 cm.
Zero Correction	0.1
Bottom Correction	1.5
CRITICAL HEIGHT	31.5 cm.
" VOLUME	10.21 ℓ ✓ 3.66 ✓
" MASS	3.93 kg ✓ ~~3.67~~ kg. x

H/X 61.8

H/X 61.8

Experiment 248 N/X = 62.1 8/17/49

Cronin
Fox
Moffitt

8" Al Cylinder with 3½" Stainless Steel + Water-filled Reflector Tank

Part A. Water Filled top Tamper kept in contact with solution 10^45

Trip Point 5.8 on # 200 scale #7 Trips @ 3" above 5 mg Ra

#6 trips gm 0.7 9.0

Source @ +6 cm. 8.0 cm from bottom.

Instrument Scales Control Blade 0.0 Not in use

#3 X10 #6 X25 at beginning of exp. 10^52

#4 X100 11^15

#5 X1 11^22

Note: Straps were fastened around the split cylinders of stainless steel to prevent them coming apart & inadvertent approach to criticality. Also made sure that water was in between layers of steel so they would not separate during experiment & allow entry to enter.

START		Hr.	C	C	1/M	1/M	Remarks
	9^32	10.4	9.0, 9.0	11.0, 11.0	1.0	1.0	#3 MT
	9^51	15.9	17.	22.0	.56	.50	#1 being used
	10^02	19.9	39	52	.23	.21	Stopped filling from #1
	10^15	21.0	65.64	106, 107	.14	.10	from #2
	10^25	21.9	139	240	.065	.045	

P At this point the tamper was left in contact with top of solution & the control rod lowered to insure that "plugging" of top tamper holes did not increase criticality more than rod decreased it. At no point was there any increase in the activity level. When control rod was on bottom, solution began to "seep" as seen in sight glass was 23.8 cm.

H Another experiment showed that a column of air outside of stainless steel shell in water had no measurable effect on the counts when moved from extreme "in" position to all the way out.

P Note the extremely straight 1/M curve for the #1 (Boron shielded) Counter

8/17/49

Reflector Tank

With Soln.

5 mg B

						Est. critical
10th	22.4	463	785	.02	.014	22.6

22.6 Critical with Cd rod @ 38 cm

CRITICAL WITH SIGHT GLASS at 22.6

Port B Top Tamper was raised to 70 cm. Taking it out of way. Began adding soln. again using original background

Set use

4 of exp.

10th	22.6	51	76.5	.18	.14
11th	24.1	113	188	.08	.059
11th	25.1	Critical with Control Rd @ 28 on scale			

5 cm more soln.

Drain Gone ∞ 0 cm

24.95 Subcritical @ 24.95

Inventory 18 cm (in 8" reflector) in #1

18 cm (" " ") " #2

DV + 10.3 cm (" " ") " #3

—o—

Exp 248 A. SIGHT GLASS 22.6

ZERO CORRECTION 0.1

BOTTOM CORRECTION 1.5

CRITICAL HEIGHT 24.2 cm

" VOLUME 7.84 L 7.85

" MASS 3.03 Kg ~~2.84 Kg~~ x 2.82 L H/X 61.8

Exp 248 B SIGHT GLASS ~~25.0~~ 25.0

ZERO CORRECTION 0.1

BOTTOM CORRECTION 1.5

CRITICAL HEIGHT 26.6 cm

" VOLUME 8.62 L

" MASS 3.09 Kg H/X 61.8

64

8/17/49

Exp. 249

For Cronin Calkihan

8" al Reactor - H/X ~~=70~~ 62.1

Enclosed in 2" ϕ Stainless Steel, surrounded by Water.

Top Tempr filled with water.

Trip points same as 248

Dust Holes: 3×10, *4×10, 5×2, 6×25 -

A 1:05	Filling from #3 -	I	II			
:09	H=10.5cm	9.5	15.0			#3 Empty; filling from #2.
		9.0	14.5			
		9.3	14.8	I	M' II	
:18	=16.0	14.0	27.5	0.66	0.66	
:26	=20.0	22.5	35.0	0.41	0.42	
:35	=23.0	38.5	70.5	0.24 ~~0.25~~	0.21	
:45	=24.5	71.5	148.5	0.13	0.10	
:57	=25.5	196.5	393.5	0.05	0.04	
2:09	=25.8	Not CRITICAL				
:16	= 26.0	CRITICAL WITH C.R. at 33.0cm i.e. C.R. 1cm below surface.				

CRITICAL WITH SIGHT GLASS AT ~~26.0~~ 25.9 Reconsidered after running 255 & noting behavior of control rod.

Raise Tempr to 70cm - i.e. at top of reactor

B	=26.0	51.5	94.5	0.18	0.14	Stop filling from #2; filling from #1
:25	=27.3	103	195	0.09	0.08	
:40	=28.5	CRITICAL WITH 6cm CR in Solution -				
:42	=28.3	SUBCRITICAL - SLIGHTLY.				
		CRITICAL AT SIGHT GLASS RDG = 28.4cm.				

Exp 249A

SIGHT GLASS	25.9
ZERO CORRECTION	0.1
BOTTOM CORRECTION	1.5
CRITICAL HEIGHT	27.5cm
VOLUME	8.92ℓ ✓
MASS	3.44kg ~~3.38kg~~ ✓

H/X 61.8

Exp 249B

SIGHT GLASS	28.4
ZERO CORR.	0.1
BOTTOM CORR.	1.5
Critical Hgt.	30.0
VOLUME	9.73
MASS	3.44

H/X 61.8

EXP 250 8/17/45 FOR CRONIN CALLIHAN.

8" Al Unfinished bar surrounded by 2" of Stainless Steel — H/X = ~~66.3~~ 63.6

Top temp empty —

Trip pts, inst. scales, etc same as 249.

		I	II			
2:55	H = 10.9cm	~~54.0~~	~~74.5~~			#3 EMPTY. FILLING from #2
		~~24.0~~	42.5			
		17.5	29.0			
		19.5	28.0			
		18.5	28.5			
3:10	= 16.2	28.0	45.0	0.66	0.63	
18	= 21.9	43.0	75.0	0.43	0.38	
37	= 27.8	74.5	132.5	0.25	0.21	#2 Empty — filling from #1
28	= 33.0	161.0	298.5	.115	.069	
45	= ~~35.4~~ 35.5	NOT QUITE CRITICAL				
50	= 35.8	"	"	"		
52	= 36.2	"	"	"		
55	= 36.6	"	"	"		
58	= 37.0	"	"	"		
4:02	= 37.5	"	"	"		
:05	= 38.1	Probably just critical with rod out				
	= 38.2	Supercritical with rod out.				

CRITICAL WITH SIGHT GLASS = 38.1 cm.

ZERO CORRECTION 0.1

BOTTOM CORRECTION 1.5

CRITICAL HEIGHT 39.7 cm.

Volume 12.9 ℓ ✓

Mass ~~4.97 kg~~ 4.63 kg

H/X 61.8

4.62 by α

from #1

GLASS 28.4

0.1

1.5

30.0

9.73

H/X 61.8

Exp. 251 A 8/19/49

8" al 1" stainless steel + water H/X = ~~61.3~~ 62.1

Cronise
Fox
Morfitt
Schuske

instrument scales 3" – x10 4" – x200 (meter) 5" – x2
6" – x25

Source 8.0 cm from bottom

Trip point

Time	Height	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
12:40	10.6	95,95	105,10	1	1	"3 Non empty
12:52	18.0	135	158	.704	.646	" filling from 1"
1:02	21.9	175	190	.543	.526	made a source jerk at this point
1:20	24.3	31.0	220	.446	.455	~~filling~~ No. 1 empty
1:30	28.0	41	51	.232	.196	filling from 2"
1:45	29.9	89	122	.107	.082	
2:02	31.0	267	379	.035	.028	cd. blade effective in this exp.
2:17	31.5	slightly super critical with control rod out of tamper. Just critical with control rod out of bot.				

Conclusion: Critical @ 31.5 cm on sight glass 8/19/49

Exp. 251 B

Top tamper at 70.0 cm.

Time	Height	C_1	C_2	$1/M_1$	$1/M_2$	
2:22	31.5	87	84	.166	.119	
	33.0	145	219	.065	.0457	
~~2:45~~	34.0	Super Critical with rod was 30 cm from the bottom				
2:45	33.9	Sub Critical				
		Critical @ 34.0 cm on sight glass.				

Drained back to 24.3 to check corresponding point in Exp 251 A Calibration.

Height	C_1	C_2	$1/M_1$	$1/M_2$
24.3	232	29.5	.413	.340

Drain back to 18.0

Height	C_1	C_2	$1/M_1$	$1/M_2$
18.0	15.0	19.0	.963	.526

	31.5
Bottom Correction	1.5
Zero Correction	0.1
Crit. Ht	33.1 cm
" Vol	10.73ℓ
" Mass	4.12 kg
	3.88 kg ✗
	± 0 ✓
	H/X 61.8

Sgt Glass	34.0
Bottom Corr.	1.5
Zero Corr.	0.1
Crit Ht	35.6

Crit Ht.	35.6 cm
" Vol.	14.5ℓ
" Mass	4.1 kg
	H/X 61.8

Cronin
Fox
Morfitt
Schuske

Time
3:15
3:30
3:40
3:50
4:00

Exp 252 8/19/49

362.1

8" al 1" stainless steel no water
H/X = ~~66.3~~ 62.1

Cronin
Fox
Moffitt
Schuster

Source 16.0 cm from bottom

Time	Height	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
3:15	18.3	19.0 - 19.0	36.0 - 36.0	1	1	
3:30	26.0	39.0	76	.487	.474	
3:40	33.0	55.5	103	.345	.350	2" empty at 36 cm
3:50	39.2	78.0	146	.244	.246	
4:00	46.6	107.	215	.178	.168	1" empty at 46.6

Conclusion probably safe to results in doubt

Solution inventory 1" 18 cm 8" cyl
2" 16 cm 8" cyl
3" 10.6 cm 8" cyl + DV

4th point

in 4p.

31.5
TION 1.5
TION 0.1
38.1 Cm
10.732
4.12 kg
3.88 kg x
+ 0 ✓
3.65 H/X 61.8
ZED 34.0
CER. 1.5
AER. 0.1
HK 35.6
1 vol.

X 61.8

68

8/22/49

Exp 253 - H/x = ~~66.3~~ 62.1

Fox
Cronin
Callihan

8" Al reactor - 1½" Stainless Steel Reflector.
Enclosed by H₂O -
H₂O in top damper.

TRIP POINTS #4 - 5.8 x 200; #6 7 x 1000 - , #7 - in

SOURCE ZERO = 8cm

SOURCE AT 20 cm -

Control Rod Zero - 8cm

Instrument Scales - #3 x 10; #4 x 100; #5 x 2, #6 x 25 -

2:55	Filling from #3					3:30
3:05	H = 10.3"	#3 I empty; filling from #2				3:33
3:10	= 13.5	15.0	8.5			3:43 PM
		14.5	8.0	M⁻¹		3:47 PM
		14.8	8.3	I	II	4:00
3:20	= 18.3	22.0	15.5	0.67	0.56	4:05
		34.5	30.5	.43	.27	4:10
3:25	= 22.3	33.5	31.5			4:18
3:32	= 24.9	62.0	63.5	.239	.131	4:24
3:50	= 26.8	151.5	165.0	0.098	0.05	4:34
4:00	= 28.0 CRITICAL - CR at 36.5cm (36.5 - 8.5) = 28.0 cm ie top of reactor at top of solution					Stop filling from #2, filling from #1 4:53
07	= 27.9cm. Very near critical with ref end					5:05

CRITICAL WITH SIGHT GLASS = 27.9

Inventory - #1 - 18 cm = 8" reactor
#2 - 18 " "
#3 10.3 + Dr.

5:10

5:17

SIGHT GLASS 27.9 cm
BOTTOM CORRECTION 1.5
ZERO 0.1
CRITICAL HEIGHT 29.5 cm
" VOLUME 9.56 ℓ ✓
" MASS. (3.68 kg) ~~3.43 kg~~ x
343 g x
H/X 61.8

5:23

5:40

3/23/49

Fox
Cronin

2/23/49 Exp. 254 H/X = ~~66.3~~ 62.1

Bulletin 3" #1 Reactor 1½" Stainless steel Reflector

For no H_2O reflector

Inversion

Trip Pts — #4 5.8 × 200 #6 7 × 1000 #7 at 3½" with Po Source

Source zero at 8.8 cm set on scale at 23 cm = 15 cm from bottom

Control Rod zero 8.5 cm

Starting Inst. scales #3 ×10 #4 ×100 #5 ×2 #6 ×25

3:30 PM	Red light on					
3:33 PM	Filling from #3					
3:43 PM	11.0 cm	#3 MT	Started Filling from #2			
3:47 PM	~~15.0~~ 15.9 cm	#1 15.5 / 15.5	#2 21.0 / 20.5	C_1 1.0	C_2	
4:00	28.9	33.5	49.5	.463	.424	#5 put on ×5 scale
4:05	26.9 cm	43.0	65.5	.36	.32	
4:10	28.6 cm	X				Cyl #2 MT started cyl #1
4:18	33.7	78.0	129	.198	.163	
4:24	37.9	124	216	.126	.097	#3 on ×20 #5 on ×10 scale
4:34	42.6	300	543	.051	.039	#6 on ×20 #3 on ×60 scale
4:53	45.3	1118	~~####~~	.014	.019	#5 on ×100 #3 on 100
		1146	1082			Read on ×200
5:05	46.0	Too high to Count				

2 gallons from #1 + at top of solution

Rod out not critical

5:10 46.6 Rod at 46 on scale − 8.5 = 37.5 cm out. 46.6 − 37.5 = 9.1 cm of Rod still in } Critical

5:17 46.3 Critical with Rod at 50 cm − 8.5 = 41.5 46.3 − 41.5 = 4.8 cm of Rod still in

5:23 46.2 Rod all out, system very slightly sub Critical

5:40 Critical at 46.25 ± .05 cm (on Sight glass) = 46.25 cm

Drain back

#1 - 18 cm

#2 - 18 cm

#3 - 11 cm plus dead Vol.

Bottom Correction 1.5

Zero Correction 0.1

Critical Height 47.85 cm

Volume 15.5 l ✓

Mass ~~5.57 kg~~ 5.16 kg ~~5.55~~

H/X 61.8

70

8/24/49

Experiment 255 H/X 66.5 62.1

For Monitt Crown Callihan

8" Aluminum Reactor 2" stainless + water in Tank Report of 249

Source 9 cm from bottom. Trip Points 0.8 as Read 512x200 ; 1/2

All others working

Port A Top Tamper filled with Water

Time	Instruments.	#3x10 H.V. cm	#4x100 C1	#5x2 C2	#6x25 1/M	#7 1/M2	#7 in Tenors	
							Filling From #3	
9:53 AM								
10:01 AM		10.6	6.5, 6.5	3.0, 3.5	1.0	1.0	#3 MT	
10:15		19.1	15.5	12.0	0.42	0.27 0.29	From #2.	2:55
			15.0	11.0	—	0.29		
		~~22.0~~ 21.9	26.0	20.5	0.25	0.17		
		25.5	34.1	31.2	.019	0.011	From #1	3:08
		25.8	Super Critical with rod @				30.	:16
	Dramboca	25.8	"	"	"	"	40. slow rise	:27
		25.7	Slightly subcritical @ this rigid width					:39
		rod all way out						:46
								:52
	Conclusion:	Critical with rigid glass @ 25.75 cm						4:07
								=12
								=17
								=19

— —

SIGHT GLASS	25.75
Bottom Correction	1.5
Zero Correction	0.1
CRITICAL HEIGHT	27.35 cm
" Volume	8.87 ℓ ✓
" Mass	~~3.17 kg~~ 3.17 kgx
	318 gx
	H/X 61.8

Inventory same as initial

EXPERIMENT ~~266~~ 256 8/24/49

8" Al reactor - H/X = ~~63~~ 62.1

3/4" Stainless Steel around reactor, followed by H₂O. H₂O in top damper.

Source at 23 cm above bottom

Foil strips 3×10, 4×100, 5×2, 6×25 -

Counter #1 near in paraffin only

" #2 " " " + brass shield

FOX
CRONIN
MORFITT
CALLIHAN

Repeat of 249

5/2×200, #4

2nd Run #3

MT

#2.

		I	II		
2:55P	H = 16.2 cm.	5.5	~~3.0~~		
		5.5	5.0		
		5.5/5.5	4.5/5.0		
3:08	= 22.1 cm	9.5	10.0	.58	.50
:14	= 25.0	14.0	16.5	0.39	0.30
:27 slow rise	= 28.1	27.5	22.0 / ~~27.5~~	0.24	0.19
:37	= 32.0	184.0	248.0	0.03	0.02
:46	= 32.5-	NOT CRITICAL			
:52	= 32.85	CRITICAL WITH C.R. at 32cm., i.e.		3.7 3.5/22.5	32.8 28.5/4.3 cm below sol. level.
4:02	= 32.7	" " " at top of solution -			Effect of one control rod withdrawn 10 cm above sol. level
:12	= 32.6	" " " " 43cm, i.e. 2 cm above solution -			
:17	= 32.5	" " " " 45.5	4.5 - "		
:19	= 32.4	Slightly sub-critical.			

CRITICAL WITH: SIGHT GLASS = 32.45 cm

Zero Corrector = 0.1

Baffle = 1.5

CRITICAL HEIGHT = 34.05 cm

" Vol. = 11.04 ℓ ✓

" Mass = ~~4.3~~ 4.37 kg

~~4.37~~ kg x

~~3.95~~ /

3.96 kg x

H/X 61.8

47 kg x

8 kg 8

61.8

INVENTORY: #1 - 18 cm - 8" reactor

#2 -

Experiment # 257 H/X = ~~663~~ (62.1) 8/25/49

8" Aluminum Reactor 1/2" Stainless Steel + Water — Cronin, Fox, Morfitt

Source @ 15 cm. (7 cm off bottom)
Trip Points #4 5.8 x 200 #6 7 x 1000

Instruments #3 x 10, #4 x 100, #5 x 2 #6 x 25

Time	Soln. Ht.	C_1	C_2	1/M	1/M	Remarks
2:05	9.2	5.0, 5.5 ✓	8.5, 3.0, 3.5	1.0	1.0	#3 NT

Tried to empty other cylinders; 150-200 cc in #4 not empty
did not try Cylinder E, which was filled with Weak solution.

2:30	18.0	7.5	7.5	.67	.47	From #2
2:44	25.9	14.5	18.5	.34	.19	Stopped #2
2:52	30.0	30.5	42.5	.165	.082	From #1
3:08	33.1	Not Critical Est. Crit 33.4				
3:20	33.2	Super Critical with Rod @ +0.0				
3:27	33.1	Subcritical with Rod out. Tamper Down.				

Conclusion Critical @ 33.15 cm Sight Glass Reading.

— —

Drainbase
Cyl #1 — Cm in 8" cyl. ~ 18.5
#2 — ~ 18.5
#3 — ~ 9.5 + DV

SIGHT GLASS	33.15
Zero Correction	0.1
Bottom Correction	1.45
CRIT HT	34.70 cm
~ VOL	11.25 ℓ ✓
~ MASS.	(4.33 kg.) ~~4.03~~ kg. x 4.04 kg X
H/X	61.8

1:40	Red ℓ
	Sol'n
1:50	9.3
2:10	18.0
2:24	~~20~~ 23.
2:27	27.1
2:35	28.1
2:47	30.0
3:02	31.0
3:11	31.1
3:21	31.3
3:30	D

Sou
Instr
Trip
C
#1
#2
#3

33.1
33.8

H/X = ~~66.3~~ 62.1 8/25/49

EXPERIMENT 258

8/26/49

- Water

Cronin
Fox
Morfitt

8" Al Reactor - H/X = ~~66.3~~ 62.1
1/4" Stainless Steel + Water as reflector.

Fox
Callihan
Cronin

Source at 15 cm - (7 cm for bottom)

Instrument Scales: 3x10; 4x10; 5x2, 6x25, -
Trip Points; #4 - 5x200; ~~#6 = 6x1000~~ #6 - 7x1000, #7 OK -

Remove #3 MT

#4 not empty
Wash solution.

	1:40	Red Light on Filling from #3 cyl.				
		Soln Ht.	#1	#2	$\frac{C_1}{C}$	$\frac{C_2}{C}$
	1:50	9.3	5.0	2.5		#3 MT
#7 From #2			6.5	3.0		
19 Stopped #2			8.5	3.5		
082 From #1			7.5	3.0		
			C_1 7.0	C_2 3.0		
						Filling from #2
10.0	2:10	18.0	13.0	8.0	.538	.375
Tamper Down.	2:24	~~23.0~~ 23.9	20.5	16	.342	.187
	2:27	27.1				#2 MT Start #1
Low Reading.	2:35	28.1	46.0	40.5	.152	.074
	2:47	30.0	114	105.5	.061	.028
	3:02	31.0	573	536	.012	.0056
	3:11	31.1	NOT QUITE CRITICAL WITH ROD OUT			
	3:21	31.3	CRITICAL WITH 3 cm of ROD IN			

CRITICAL AT 31.2 ± 0.1 cm on Sight Glass

Bottom Correction 1.45

Sight Glass zero 0.1

~~Corrected~~ Critical Height 32.75 cm C.

Vol. 10.62 ℓ. ✓

Mass. 4.09 kg 3.81 Kgx

H/X 61.8

3:30 Drain back
#1 - 18 cm
#2 - 18 cm
#3 - 9.5 + DV

X

33
33.8

74
8/29/49
HENRY
FOX
CRONIN
CALLIHAN.

EXPERIMENT 259

8" AL REACTOR; WITH 1/8" S. STEEL SHELL.

H/X = ~~66.7~~ 62.1

8"

WATER ENCLOSED; WATER IN TOP TAMPER.

Source - 16 cm on scale - 8 cm from bottom
TRIP PTS. #4 - 5.5 K20, #6: 8 K 1000 - #7 OK —

INST SCALES: #3 x 100; #4 x 10, #5 x 2, #6 x 25
Dump valve opened - Solid particles - ~~possibly~~ ~~yellow~~ - in 3" section - Appear thicker they are not $UO_2(NO_3)_2$

#2 Counter in B + paraffin shell -

1:15P Filling from #3.
20 H = 9.5 cm.

	I	II
	7.5	4.0
	7.5	3.5
→	7.5	3.8 ←

#3 empty; filling #2.

				I	II	
:30	=18.3	15.0	9.0	0.50	0.42	
:40	=21.1	19.0	14.5	0.39	0.26	
:45	=24.0	30.0	26.0	0.25	0.15	Stop filling from #2; filling from #1.
:55	=27.4	190.5	186.0	0.04	0.02	
2:05	=27.8	Sub Critical. Rod out				
:13	=28.1	CRITICAL C.R at 33 ie 3a below sol. level.				
:23	=28.0	Very slightly sub critical with rod out.				

CRITICAL AT SIGHT GLASS = 28.0 cm
Zero Correction 0.1
~~Bottom~~ Correction 1.5
CRITICAL HEIGHT 29.6 cm
CRITICAL VOLUME 9.60 ℓ ✓
MASS. ~~3.70 Kg.~~ 3.44 Kg. x ✓
H/X = 61.8

3:35P H = 9.5
3:50 = 16.9
:55 = 19.9
4:05 = 22.5
4:12 = 24.0
:25 = 24.7

Inst

PRESEN

INVENTO

8/29/49

Exp 260

62.1

SHELL. H/X=~~66.7~~

8" Al Reactor - with 5 - 1" OD Al cans filled with water - System enclosed in water, Hood in top tamper -

CRONIN
HENRY
FOX
CALLIHAN

TOP TOMPER.

—

25

ection - Cans

Trial Soln #3x10 #4x100 #5x2 #6x 25

H/X = 62.1

		I	II	
3:35P	H = 9.5 cm.	9.0	4.5	
		9.0	4.0	
		9.0	4.3.	M^{-1}
3:50	= 16.9	16.0	12.5	0.56 0.34 filling from #2K
:55	= 19.9	21.0	21.0	0.32 0.21
4:05	= 22.5	63.0	57.0	0.14 0.08
4:12	= 24.0	NOT CRITICAL.		
:25	= 24.2	Super Crit - Pool out; Critical with rod at 42 cm, ie 10 cm above sol.		

) for #2K filling for #1A

CRITICAL WITH SIGHT GLASS = 24.1 cm

Zero Correction 0.1

~~Bottom~~ Correction 1.5

CRITICAL HEIGHT 25.7 cm

level.

~ VOLUME 8.33 ℓ

~ MASS ~~3.21 kg~~ 2.99 Kg x ~~.96~~

H/X 61.8

PRESENCE of Al CANS DOES NOT AFFECT CRITICAL MASS SIGNIFICANTLY—

INVENTORY: #1 - 18 cm in 8" Reactor

#2 · 18 " " 8" "

#3 9.5 " 8" " + Dr.

3.44 Kg. x

76
8/30/49

EXPERIMENT 261

CRONIN

FOX

CALLIHAN.

8" Al Reacto - H/X = ~~66.3~~ 62.1

Enclosed by 5 - 1" OD Al shells filled with water - H₂O in top tamper; 6" H₂O in tank & provides bottom tamping

Purpose: to examine thickness of water & fuel ∞ tamping -

TRIP PTS #4 - 5 5 x 200 ; #6 - OK, #7 OK

Source at 7 cm - = 19 on dial (bottom screw).

Instrument Scales - #3 x 10; #4 x 100; #5 x 2 #6 x 2.5 #7

Fillings from #3 -

H = 9.4

	I	II
	25.5	19.0
	24.0	19.5
	24.75	19.3

#3C empty, filling from #2K.

		I	II
1:00 P	= 16.8	55.0	70.5
:08 P	= 21.0	106.5	158.5
:15 P	= 23.9	SUB CRITICAL - ROD OUT.	
:18 P	= 24.3	" " " "	
:22	= 24.7	" " " "	
:27	= 25.1	" " " "	
:32	= 25.7	" " " "	
40	= 26.15	CRITICAL WITH ROD AT 41.5	41.5 / 33 - 26 = 7 cm above sol
42	= 26.0	Sub CRITICAL	

0.45 0.27
0.23 0.12

CRITICAL AT SIGHT GLASS = 26.1 cm.

or in 10" reactor

10.5 cm
10.5 cm.
D.V. + 6 cm.

Inventory: #1 18 cm = 8" reactor
#2 18 " " "
#3 9.5 " " " + D.V.

SIGHT GLASS	26.1 cm.
Bottom CORRECTION	1.5
Zero -	0.1
CRYTICAL HEIGHT	27.7 cm
VOLUME	9.98 L V
MASS	~~3.46 kg.~~ 3.29 Kg X
	H/X 61.8

Leak in 8" Al reactor -

A. - 10"

TRIP PTS

Instruments

Time	Solu
9:22 am	5.9
9:43	7.1
9:50	12.2
10:00	13.1
10:10	14.5
10:15	14.4

Conc. →

B -

Reac
was

→ Fluct
was d
liquid
Original

10:50	14.65
11:00	14.9
11:15	15.3

Conc → Conc

CRONIN

FOX

CALLIHAN.

EXPERIMENT 262

MORFITT

FOX
CALLIHAN.
McLENDON

A. - 10" Al Reactor. H/x = ~~6~~ 362.1 Tampool

Purpose: To examine tamping effect of various thicknesses of water.

Reactor enclosed by 4-(1" OD) Al shells
water filled. Tank also filled with water.

TRIP PTS: #4 - 5×200; #6 - #7

Source 0 @ 8.5 scale
Set @ 13.5 scale

Instrument Scales #3 ×10, #4 ×10, #5 ×2, #6 ×25

Time	Soln Ht.	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
9:22 am	5.9	8.5	7.5			#3 MT. - From #2
		8.5	7.0			
9:43	7.1	8.5	7.3	←		From #2
9:50	12.2	~~24.5~~	28.5	0.35	0.26	
10:00	13.1	37.5	50.0	0.23	0.15	
10:10	14.5	CRITICAL WITH ROD AT 25 on SCALE.				
10:15	14.4	SUBCRITICAL -				

Conc. → CRITICAL AT SIGHT GLASS = 14.5 cm.

B - Reactor enclosed by 4-(1"-O.D.) Al shells, water filled only - (Tank ~~AT~~ → 6" H_2O in bottom.)

→ Fluctuation of tank bottom occurred when water was drained giving rise to a 1.5 mm. increase in liquid level (sight glass reading) Soln Ht. = 14.75 cm. Original reading was obtained by refilling tank.

10:50					
	14.65	610.5	485.	0.014	0.015
11:00	14.9	SUB CRITICAL. ROD OUT!			
11:15	15.3	Just critical with rod out.			From #1

Conc → Critical hgt. 15.3 cm on sight glass.

In water -

Tamping -

- #2K.

26 = 7 cm above soln

1.5 cm
1.5 cm.
6 cm.

cm.
-
1
7 cm
82 V
~~Ht Kg.~~ 329 Kg x
1.8

C. Same as B except only 3½" water on top tamper.

Time	Soln Ht	
12:56 pm	15.3	Sub critical
1:08	15.7	Super " ; Rod @ 21.0 on scale.
1:17	15.55	Slightly Super Critical ; Rod @ 28.
1:22	15.45	" Sub Critical - Rod out -

Conc. → Critical at sight glass = 15.5 cm

D. Reactor enclosed by 2 (1" O.D.) Al shells = Water filled only (+1¾" inches water on top tamper. Water in bottles of total 6" deep.

Time	Soln Ht.	I	II	1/M,	1/M₂	Remarks
		~~337~~	~~268~~	~~.025~~	.027	From #1
2:15	15.5	334	268	.025	.027	From #1
	15.8	373	296			

Background has completely changed due to removal of shielding effect of water. This is what makes the curve appear to 'slide' into criticality. Actually the background has increased greatly due to removal of water so that the "1/M" of .025 actually is about 0.3 much higher on the graph. We estimate the probable background below:

Take a fictional background of 100 & recompute above 1/M

Repeat of above data	15.5	334	268	.33	.37
	15.8	373	296	.27	.34
2:45	16.3	524	431	.19	.23
3:00	16.7	737	634	.136	.158 Est crit 17.0
3:08	17.0	978	862	.102	.116 " " 17.2
3:17	17.3, 17.6	Too high too count			
3:23	17.8	Critical with Rod @ 27 cm			

Conc. → Critical Height 17.7 cm @ sight glass.

Have
& changes
for next

Exp. 262
Completely tam

262
SIDE TAMPED B
6" TOP, 6" BA

262 C
SIDE TAMP - 4
6" BOTTOM - 3

262 D
SIDE TAMP
6" Bottom; 1¾

Have changed to one-(1"-0) [redacted] pair of shells & changed depths of water in top tamper to 7½" for next experiment.

CALE.
@ 28.
OUT –
m
shells
top tamper

Remarks
From #1
7 From #1
ielding effect
site criticality.
e to removal
t [redacted] 0.3
d below:

upute above 1/M
7
14
23
158 Est crit 17.0
146 " " 17.2

Exp. 262 A
Completely tamped

SIGHT GLASS READING	~~14.5~~ cm.	14.5 cm
ZERO CORRECTION	1.07 ✓	1.22
BOTTOM CORRECTION.	0.93 ✓	0.93
CRITICAL HEIGHT.	~~16.4~~	16.65
" VOLUME	8.36 ℓ	8.43 ℓ ✓
" MASS. (Kg X)	3.22 Kg.	~~3.2 Kg~~ ~~3.05~~ 3.02 Kg X
	H/X 61.8	

262 B
SIDE TAMPED BY 4 SHELLS.
6" TOP, 6" BOTTOM TAMP

SIGHT GLASS RDG	15.3 cm	
ZERO CORRECTION	1.07	
BOTTOM "	0.93	
CRITICAL HEIGHT	17.30 cm	
" VOLUME	8.76 ℓ ✓	
" MASS	~~3.37 Kg~~	~~3.15~~ Kg X 3.14 Kg X
	H/X 61.8	

262 C.
SIDE TAMP - 4 SHELLS
6" BOTTOM - 3½" TOP

SIGHT GLASS	15.5 cm	
ZERO CORRECTION	1.07	
BOTTOM "	0.93	
CRITICAL HEIGHT	17.50 cm.	
" VOLUME	8.87 ℓ ✓	
" MASS.	~~3.42 Kg.~~	~~3.18~~ Kg X 3.18 Kg X
H/X	61.8	

262 D
SIDE TAMP 2 SHELLS
6" BOTTOM; 13½" TOP

SIGHT GLASS	17.7	
~~ZERO CORRECTION~~	1.07	
BOTTOM CORRECTION	0.93	
CRITICAL HEIGHT	19.70 cm.	
" VOLUME	9.98 ℓ ✓	
" MASS	~~3.84 Kg.~~	~~3.59~~ Kg X 3.58 Kg X
H/X	61.8	

~~8~~ 9/16/49

EXPERIMENT 263.

For McLendon Henry Callihan

10" Al Reactor H/X = ~~66.3~~ 62.1

TAMPER: One Al shell (7/8" ID) filled with water.
7/8" water in top tamper
6" water in tank.

TRIP POINTS : #4 = 4.8x200; #6 - #7 #6.

INSTRUMENT SCALE #3 x10; #4 x100, #5 x2, #6 x25.

SOURCE: 7 Cm from bottom : scale = 15.5cm.

Time	Sol. Ht.	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
10:40AM	Filling from #3 - Empty at 6.6cm.					
10:46AM	Filling from #2					
10:50AM	8.5	20.0 / 20.0 } 20.0	15.5 / 16.5 } 16.0			
10:57						
11:05	16.2	62.5 / 63.0 } 62.8	72.0 / 71.0 } 71.5	.319	.224	
11:20	Filling from #1 ; #2 Empty at 16.2					
11.24	17.5	82.5	97.0	.243	.165	
11:32	20.0	173.5	223.0	.115	.072	
11:42	21.5	456.0	626.0	.044	.026	
11:50	12.0	Sub-critical - Rod Out.				
11:59	22.4	" " "				
12:02	22.8	~~Rod~~ Critical ; Rod at 24.5 on scale; Rod 6cm. below sol. surface.				
12:06	22.6	" " " 18.0 " " ; " 2.5" " " "				

CRITICAL WITH SIGHT GLASS READING = 22.5cm

Zero Correction	1.07
Bottom Correction	0.93
	24.5 ~~24.4~~ cm
CRITICAL HEIGHT	
" VOLUME	12.41 L.
" MASS	12.4 x 1.547 x 0.249 = (4.78 L.) ~~4.41~~ Kg. x 4.45 Kg X
H/X	61.8

10"

A. Trip

Instr

Source

Time:

1:35

1:49

1:55

2:04

2:13

2:18

2:20

2:25

Rea

Cri

EXPERIMENT 264 9/16/49

10" Al REACTOR - A/X - ~~66~~ 62.1 Fax

TAMPING: 4 Al SHELLS - 1" OD AROUND REACTOR, WATER FILLED | MELENDON HENRY CALLIHAN

No BOTTOM OR TOP TAMPER. (TANK EMPTY).

PURPOSE: TO COMPARE TAMPING EFFECTS OF H_2O, H_3PO_4, $UO_2(NO_3)_2$ ETC. DESIRABLE TO HAVE NO MIXED TAMPER IE, H_3PO_4 ON SIDES AND H_2O ON TOP AND BOTTOM. ALSO NOT PRACTICAL TO BOTTOM AND TOP TAMP WITH H_3PO_4 ETC. TO OBTAIN REFERENCE POINT WILL REDO A H_2O TAMPED EXCEPT NO TOP OR BOTTOM TAMPER.

A. Trip Points: #4 4.8x200 #6 #7 No

Instrument Scale: #3 x 1.0 #4 x 100 #5 x 2 #6 x 2.5

Source: 5 cm. from bottom : Scale = 13.5

Time:	SOL. NT.	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
1:35 PM	10.0	14.5 / 15.0 } 14.8	12.5 / 12.0 } 12.2			[6.5 cm in #2]
1:49	12.9	20.0	21.0	.740	.581	filling from #1
1:55	15.5	36.5	32.5	.470	.376	
2:04	18.4	61.0	91.0	.243	.172	surface.
2:13	20.0	146.0	175.0	.101	.070	[0.5 cm in #1]
	filling from #2					
2:18	20.6	Sub-critical - Rod out				
2:20	21.0	" " " "				
2:25	21.25	Source dropped off support. Estimated critical point: 21.2				

.45 gX

Reactor empty when sight glass shows -1.0 cm.
or Reactor contains 1.0 cm when sight glass shows 0.0 cm.
(This value determined with no water in tamper tank -
Due to convex bottom of 10" reactor this correction is adjusted to 1.07 cm.

use data from part B

Sight glass 21.2 Volume 11.8 L.

Zero correction 1.07 Mass ~~4524~~ 4.22 Kg x 4.21

Bottom Correction .93 Volume 11.8 L.

Critical height ~~22.20~~ 23.20 Mass ~~4.28~~ Kg X 4X 61.8

82

9/16/49

Fox

McSenders
Henry
Callihan

9/19/49

Remark
Hew
Source

Experiment 264B

Repeat Pard of Exp. 264A to determine critical point alone.

No multiplication to be taken.

Source replaced on source wire ~~with~~ temporary hook.

All constants same as in Exp. 264A.

Reactor contains 1.0 cm. of solution when sight glass shows 0.0 cm.

Time.	Rods. Ht.	C_1	C_2	M_1	M_2	Remarks
~~3:40~~	20.0	Sub-critical with Rod out				
3:43	20.5	" "	"	"	"	
3:45	21.0	" "	"	"	"	
3:49	21.2	Critical				

Critical at sight glass reading of 21.2 cm

Inventory: #1 6 cm. + DV
#2 10.5 cm. in 10" cylinder
#3 10.5 cm in 10" cylinder

CRITICAL AT SIGHT GLASS = 21.2 cm
ZERO CORRECTION = 1.07
BOTTOM CORRECTION = 0.93
CRITICAL HEIGHT = ~~23.7 cm~~ 23.2
VOLUME = ~~11.70~~ 11.75 ℓ
MASS = 11.75 × 1.247 × 0.249 = ~~4.51 kg~~ 4.53 ~~4.22 kg~~ × 4.21 kg
H/X = 61.8

9|9|49.

Remarks

termine

porary

A.

ass shows 0.0 cm.

f 21.2 cm

~~4.22~~ kg x 4.21 ~~g~~

Remounted source. Placed in cask loop of stranded stainless steel then covered with paraffin.
Source on bottom of 10" reactor at scale reading = 7.5 cm.

84

9/2/49

Experiment 265A

H/X = 62.1

Crowin, (F)
Fox, (J)
Kruesi (F)*
Morfitt

10" Al Cyl. Surrounded by 20 - 1/8" thicknesses of stainless steel. Total water gap, taking nominal thickness of stainless as 1/8" is 3/8". Stainless steel surrounded on sides & bottom with water. Top Tamper also used.

H/X = 66.3

Source @ 12cm 4cm from bottom.

*Hanford representative

Instrument Scales: #5 - 2, #6 - 25, #3 - 10, #4 - 100

PMonitor. PhotoMed NG Trip: #6 @ 0.7 on 1000, #4, 6.0 on 200

Time	Subs Hgt.	C_1	C_2	$1/M_1$	$1/M_2$	
11 30	6.4	6.5, 6.5, (6.0)	4.5, 3.5, 4.5, (3.5)	1.0	1.0	#1 MT
11 45	9.2	11.5	6.5	.52	.54	from #2
11 50	11.1	17.5	10.0	.34	.35	
12 00	13.1	47.0, 46.0	32.5, 33.0	.126	.108	
12 24	13.8	124.5	90	~~.048~~ .105	.039	
12 35	14.3	Critical with Rod @ 23.5 on scale				
12 40	14.2	Not Critical with Rod all way out.				

Conclusion: Critical at Sight Glass Height @ 14.25 cm.

Sight glass	14.25
Zero correction	1.22
Bottom correction	.93
Critical height	16.40
Volume	8.31 L. ✓
Mass	(320 kg.) 2.98 kg. ✓ x
H/X	6.8

9/1/49

Crowin	10" Al.
Fox	Stai
Kruesi	
Morfitt	Cy
	at

Time	Soln. H
3:34	14.5
3:50	17.0
4:00	18.6
4:02	18.6
4:08	19.2
4:12	19.2
4:14	19.1

Conclusi

*Note

but agi

annular space o

(J. Fox) to be

the reactor.

Sight glass
Zero correction
bottom
Critical height
Volume
Mass.

9/21/49

Experiment 266

8" Thickness
minal Thickness
rounded on
used.
cm 4 cm Cotton.
#4-100
on 1000, #4, 6 cm 200

#1 MT
from #2

cm.

Grown
For
Kruesi
Morfitt.

10" Al. Cyl. Surrounded by 20 - 1/8" Thickness steel No H_2O
Starting condition same as previously (No H_2O tamper)

Background for untamped core previously measured at 28 on #1 23 on #2 sc.

Time	Solu. Hgt.	C_1	C_2	$1/M_1$	$1/M_2$	
3:34	14.5	120, 122	76, 74	.23	.31	"Borg Correction"
3:50	17.0	248	157	.113	.146	#2 MT @ 16.5
4:00	18.6	852	595	.033	.039	from #3
4:02	18.6+	489	321	.057	.072	with rod in
		Rod work ∞ 3 mm. of solu.				Est crit. 19.2
4:08	19.25	Critical with 5 cm of rod in.				Est. " 19.2
4.12	19.2	Critical with rod out.				
4.14	19.1	Sub critical				

Conclusion: Critical with sight glass @ 19.2 cm.*

Drain back same as Exp 264

*Note: upon removing steel to do Exp 267 a small but significant quantity of water ran out from the annular space around the 3" pipe to bottom of reactor. Appeared (J.Fox) to be probably filled to (or nearly to) the bottom of the reactor.

Sight glass	19.2
Zero correction	1.07
6 Bars	0.93
Critical height	21.2
Volume	10,742. ✓
Mass.	(4.13) 385 ✓
	3.86 Kg. x

H/X 61.8

9/22/49

Experiment 267

10" Al cyl 1" of Stainless Water Reflector H/X = ~~66~~ 62.1

Morfitt
Fox
Krusi
Cronin

also top and bottom tamped
Source at 12 cm on scale = 4 cm from bottom

Trip points #4 - 6 on ×200 scale } other instrument #3, 5 on most sensitive
#6 - 7 on ×1000 scale } scales - #6 on ×25 scale at start

Time	Sol'n Ht.	C_1	C_2	$1/M_1$	$1/M_2$	
		7.0		1.0		
~~11 25~~	6.6	~~6.5~~ 7.0	3.0 3.0	~~.46~~	1.0	#1 MT @ 5.6.
11 45	11.1	12.0	6.5	.58	.46	#2
11 52	13.0	18.5	11.5	.38	.26	
11 57	14.5	35.0	25.5	.20	.175	
11 45	~~15.5~~ 15.6	13.9	106	.050	.028	Stopped #3.
11 52	16.0	{ Slightly super critical				from #3
		{ Critical with rod @ 26 cm scale				
11 58	15.9	Critical with rod @ 30 cm scale.				
12 00	15.8	Not Critical				

Critical @ 15.85 on sight glass.

— • —

Drainback same as before.

sight glass	15.85	15.85 cm.
Zero correction	X 07	1.2
Bottom correction	0.93	0.93
Critical height	17.85	18.00
Vol	9.94 L.	9.12 L. ✓
Mass	~~3.48~~ 3.25 Kg. ×	~~3.280~~ Kg
		3.27 Kg
		H/X 61.9

90 1 = x = 3.25 / 3.591

9/22/49 LJ

For Morfitt Crown Krusi

10" reflec
time
#266.
the g

Time	Sol
1:30	16
1:40	19
1:34	21
2:06	24
2:10	24
2:16	24
2:22	25
2:45	26.
2:46	26.

Zero correcti
Bottom

9/22/48 LG

For Morfitt Crowell Kruse.

Experiment 268

H/X = 62.1 ~~66.3~~ H/X ~~66.3~~ 62.1

10" Al cyl. of 1" stainless steel No water reflector.

It was observed (after) that annular space this time was probably not filled with water as in #266. Only one of the shells this time was setting on the gasket.

Background (taken before experiment 267) #1 33 #2 19

"Borg Correction" 3mm.

Time	Soln Ht.	C.	C_2	$1/M_1$	$1/M_2$	Remarks
					.38	
1:30	16.1	86.5	50	.38	~~.24~~	from #2
1:40	19.0	116	89.5	.28	.21	#2 MT @ 17.0
1:54	21.0	158.5	128.5	.21	.15	from #3
2:06	24.0	380	363	.069	.052	
2:10	24.0+	285	260	.12	.07	Rod in.
2:22	23.0	683	680	~~.048~~ .044	.028	
2:45	26.05	Critical with 2cm of rod immersed in core				
2:46	26.0	Subcritical				

Conclusion: Critical @ 26.0+ on rigid glass.

Drainbox

#1 D.V + 6.
#2 12.5
#3 8.5

Zero correction: right glass 26.0
Bottom correction 1.07
Critical correction 0.93
Critical height 28.00
Vol. ~~14.2~~ L. 14.18 L.
Mass. 5.09 kg. x ✓
H/X 61.8

9,5 on most sensitive scale at start.

#1 MT @ 5.6.
#2

Stopped #2 from #3

Scale

low.

kg

88

7/22/48

Experiment 269

Cronin — 10" Aluminum Cylinder ½" stainless steel + Wax Reflector Sides, Top, Bottom

Fox

Kruesi

Moffitt — Instruments etc. same as #267

H/X 66.3 (6x.1)

Time	Sola. Ht.	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
3 25	6.3	11.0, 10.5	3.5, 3.5	1.0	1.0	from #2
3 32	12.0	23.5	12.0	.47	.29	
3 45	~~14.4~~ 14.5	47.0	30.0	.22	.12	
3 52	16.0	191.5	128.5	.06	.027	Est Crit 16.5
4 10	16.5	Critical with rod out.				

Conclusion Critical @ 16.5 on sight glass.

Sight glass	16.5
Zero correction	1.22
Bottom "	0.93
Critical height	18.65
Vol	9.44L. ✓
Mass H/X	3.39 Kg. x 61.8

9/23/49

Cronin

Fox

Kruesi

Moffitt

Henry

Time

9:29 AM

9:55 AM

10:05

10:12

10:26

10:36

E

10

Wat

betw

Inst

#5

Sou

2n

Su

6

(Scale of 16)

1

1

1

1

1

9/23/49

6.1

H/X 66.3 → 62.1

Bottom

Crowe
Fox
Kruse
Moffitt
Henry

Experiment 270

10" Aluminum Cylinder ½" stainless H/X 66.3 → 62.1
Water Reflector Sides, Top, Bottom. ⅛" Water Gap between 2nd & 3rd thickness of stainless

Instruments:
#5 on x2 #6 x25 #3 x10 #4 x100
Source Position: 12.0 on scale. #5 cm. from bottom
Trip Points: 6.4 on #4 (100/cycle) 7 on #6 (1000/cycle)

Soln ~~Hgt~~	C1	C2	M1	M2	Remarks
6.50	~~7.0~~	5.5			
	5.0	5.0			5.25
(Scale of 16) Tube on #1	~~7.0~~	5.0			
changed at mk	5.0	5.5			
	5.0	5.0			
	6.0				

Time	from #2					
9:29						
9:55 AM	12.1	9.0	13.5	.556	.389	
10:05	14.5	18.0	~~18.0~~ 30.5	.278	.172	
10:12	16.0	90.5	176.0	.055	.029	
10:26	16.3	374.0	737.0	.013	.007	
10:36	16.4	Rod at 29.0 on scale when supercritical 4.1 cm. in tamper				

Conclusion: Critical at 16.35 cm

sight glass	16.35
Zero correct.	1.22
Bottom "	0.93
Critical height	18.50
Vol.	9.37 ✓
Mass.	3.36 Kg. x
H/X	61.8

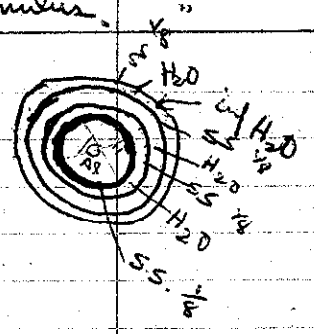
9/22/49

Experiment # 271 $H/X = 61$

9/24/49

10" Aluminum Cylinder ½ inch Stainless $2\frac{1}{8}$" annulus.

Water Reflector sides + bottom + top



For Morfitt Kruse Henry

Instruments: - same as Exp #270

Source " " "

Trip Points " " "

Time	Sol. Height	C_1	C_2	$\frac{1}{M_1}$	$\frac{1}{M_2}$
11:40 AM	6.5 cm	5.0	5.25		
11:48 AM	12.9	10.5	16.5	.475	.32
11:58 AM	15.7	58.0	112.0	.086	.046
12:14 PM	16.1	172.0	342.0	.029	.015
12:20 PM	16.2	not critical			
12:30 PM	16.4	Critical rod at 26 cm			

Conclusion: → Critical Height 16.3 with rod at 28 cm.

→ Critical Height 16.25 cm sight glass

Exp#	Reflector	Critical Ht. (Sight glass)
269	4-⅛" Stainless + Wat.	16.25 cm.
270	4-⅛" Stainless + ⅛" wat. gap + Wat.	16.35 cm
271	4-⅛" Stainless + 3-⅛" wat. gaps + Wat.	16.25 cm.

Conclusion: Effect of water layer between stainless plates will effect result only 1-2 mm at most. These were made @ thickness of ½" stainless where difference between stainless plus water reflector & water reflector alone is a maximum.

#271 : Sight glass 16.25
Zero correct. 1.22
bottom " 0.93
Critical height 18.4
Vol. 9.32 V 3.34 Kg X
Mass ~~3.47~~ ~~3.47~~ ~~Kg~~ H/X 61.8

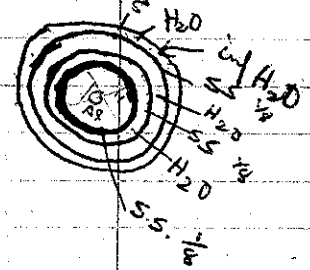
Morfitt
Fox
Henry
Schreiber
Kruse
Cronin

Time	Sol. Ht.
3:40	9.0
3:57	12.1
4:02	15.0
4:09	18.0
4:15	18.3
4:20	19.5
4:25	Morfitt Kruse Cronin only.
4:26	19.95
~~4:40~~ 4:40	20.5
4:44	20.7
4:45	20.5-20.7 Co

9/24/49 Exp. 272

62.1

10" Al Cyl. with 4 shells full of H_3PO_4 85% H/X = 66.3



Morfitt
Fox
Henry
Schreibe
Kmusi
Cronin

No other reflector present.

Instruments: # 3 } in trip emit # 3 at 80 x 200 # 6 — out of order
4 } # 4 at 6.8 x 200 PM out of order.
5

Source at ~~—~~ 15.5 cm on scale = 8 cm from bottom

Time	Set at H8	C_1	C_2	$\frac{C_1}{C_1}$	$\frac{C_2}{C}$	
3:40	9.0	37	27			
		36	27			
3:57	12.2	52	42	.712	.644	
4:02	15.0	74.5	71.	.498	.380	
4:09	18.0	156	192	.236	.141	
4:15	18.3					H2 Empty
4:20	19.5	340	446	.109	.106	
4:25	Morfitt Kmusi Cronin } only.					Schreibe Fox Henry } out
4:26	19.95	580	783	.064	.034	
4:40	20.5	Not critical - estimated critical 20.7 cm				
4:44	20.7	Critical rod at 18.5 cm				
4:45	20.5-20.6	Critical rod out				

Conclusion: critical at 20.6 cm. on sight glass.

Solution inventory same as exp 268.

—2—

Sight glass	20.7
Zero correction	1.07
bottom	0.93
Critical height	22.70
Vol.	11.5 L.
Mass	4.3 Kg x

Sight glass	20.6
Zero corr.	1.07
bottom corr.	.93
	22.60 cm
Vol.	11.45 ✓
Mass.	4.11 ~~4.08~~ Kg X
H/x	61.8

gauge.
8 cm.
ights glass.
H. (Sight glass)
.5 cm.
.35 cm
.25 cm.
ts will
e made
) between
5 alone is

9/27/49

Experiment 273

#

H/X 62.1 * 66.3

10/11/49 analysis: 86.7% H_3PO_4

9/27/49

Crowe 10" Al cyl. with 4 shells full of 85% H_3PO_4 Crowe 10"

Fox Water reflector on top & top damper. Fox no oth

Kruesi Purpose to see how much lower H_3PO_4 Kruesi

Morfitt might be effective to bring critical near. Morfitt

Core have been same except that H_3PO_4 in Bare

#272 proved to be better reflector than water. 0

When arrived in lab. H_3PO_4 was foaming out of many of top openings. Foam was washed down with water. Water run into stopper tank to slow down reaction. Reaction stopped to all intents & purposes. Top damper was then removed because evidence of H_3PO_4 on top damper. Latter was removed, cleaned, no evidence of phosphoric acid in bottom side were wiped down anyway. Damper reinserted. Liquid level in each of positions checked. In no case was liquid level more than 5" below top. Decided to finish up on phosphoric acid day. 10 25 14.

Cd. ratio

10 47 18.7

10 50 19.8

10 58 20.2

11 02 20.6

(No) It will also be necessary to repeat #272 to see if evolution of H_2 made any difference before going on with other thicknesses of H_3PO_4. (2) (3)

While damper was out checked zero by taking four readings two while filling & two while draining. Fitting Av. 1.0. Draining 0.9, 1.2 Ave. 1.07

Trip Points #4 6.6 x 100 (meter) #3: 67 x 100 (meter) Source @ 15.5 (scale)

Time	M.	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
9 30	9.2	13.0 (13.0)	13, 13.0, (12.0)	1.0	1.0	#1 MT @ 6.
9 47	12.1	33.5	36.5	.39	.33	
9 53	13.0	65.	77	.20	.16	
10 03	13.6	227.0	277.5	.057	.043	Est Critical
10 10	13.9	& Critical with rod in.				13.8
10 12	13.8	Subcritical with rod out.				

Conclusion: Critical @ 13.85 cm on sight glass.

Note that control rod only worth 1 mm. This would seem to indicate that effect of H_3PO_4 is to reflect fast neutrons rather than thermalization.

H/X 61.8

Sight glass	13.85	Critical height 16.0 8.11 ✓
Zero Correct	1.22	Vol.
Bottom	0.93	Mass 2.91 Kg ✓

* Phosphoric 86.7% H_3

10/11/44 analysis: 86.7% H_3PO_4

9/27/49

Experiment #274 Repeat of #272 H/X = 6.5 621

10" Al. cyl. with 4 shells full of 85% H_3PO_4

no other reflector present Source, instrument as per 273.

See note on #273.

Background taken as 37 on #1, 27 #2

← 3mm. difference; 1.5 mm for rod., 1.5 m. "Bump."

14.1	61.8	69.8	.60	.40

Cd. rod bump – repaired. #2 M.T. @ 18.3

18.7	213	260	.17	.104
19.8	414	467	.089	.058

20.2 Not Critical.

20.6 Critical with 2cm of rod in solution.

Conclusion Critical @ 20.6 on scale.

② Experiment #272 successfully repeated.

③ Phosphate solution not effected by nights' accident.

Drained to 9.0 cm. with #3 & #2 as before.

Sight glass	20.6
Zero correct	1.07
Bottom "	0.93
Critical height	22.60 cm.

Vol. 11.46 l ✓

Mass ~~408~~ Kg x

4.11 Kg H/x 61.8

✳ Phosphoric Acid is 86.7% H_3PO_4 by wgt spg 1.695

So 1.470 g H_3PO_4/cc or

$1.470 \times \frac{31.0}{98.0} = 0.465$ g P/cc $^{86.7\%}_{H_3PO_4}$

57% H_3PO_4 Crown

Fox

H_3PO_4 Kneeland

Worced Morfield

H_3PO_4 in

water

out of room

ater. Water 10 25

r. Reactor

ther removed 10 47

was removed, 10 50

ides were 10 55

level in 11 02

ginal level

e on phosphate ✳

ee of

ith other

ing two cubic

l Ave. 1.07

15.5 (scale)

Remove.

#1 MT @ 6.

Est Critical

13.8

ion.

een 8

two rather

16.0

8.13 & 11 ✓

2.91 Kg ✓

9/27/49

62.1

H/X 66.3

9/27/49

Experiment #275

Crowin

Fox
Kruesi
Morfitt

10" Al. Cyl. surrounded by 3" shell containing 85% H_3PO_4. No other reflector used. Set up for source, instruments as per exp 273.

			C_1	C_2	$1/M_1$	$1/M_2$	Remarks
			{37.5 (37.0)	{36 (35)	1.0	1.0	
12 35	9.2						
12 40	16.0		87.0	95.0	.43	.37	from #2
12 49	19.5		229	256	.16	.14	
1 00	19.9	20.9	~630	~720.			
1 10		21.6	Critical with Rod @ 25 on scale				
1 12		21.4	Not critical				

Conclusion: Critical @ 21.55 cm on sight glass.

Sight glass	21.55
Fix object	1.07
Bottom "	0.93
critical height	23.55

Vol.	11.93
Mass	4.28 kg
H/X	61.8

Crowin

Fox
Kruesi
Morfitt

1 45

1 50	16.0
2 05	18.0
2 14	21.0
2 21	22.8
2 29	23.5
2 39	24.0
2 42	23.9
2 47	23.8
2 45	23.7

10

conta
of ex

9.0

9/27/49

Experiment #276 H/x 6636 2.1

containing

Set up for

1/M2 Remove

.0

.37 from #2

14

eight glass.

Crossin

10" Al. Cyl. surrounded by 2" 1" OD shells containing 85% H3PO4. No Stitt reflector used. Set up of exp 273

For Kruesi Murphy

1 #5

	C1	C2	1/M1	1/M2	
9.0 }	37.5	24	1.0	1.0	
}	37.	24			
1 #5					
16.0	83	73.5	.45	.33	
18.0	110	111	.33	.22	#2 MT @ 8.4
2 #5					
2 #4					
21.0	221	261	.17	.085	
2 #1					
22.8	546	721	.068	.033	
2 #9					
23.5	1100	1036	.033	.023	
2 #9					
24.05 (including rod)	Rod at 22 cm scale.		Critical		
2 #4					
23.95	Rod @ 27 cm scale.		Critical		
2 #4					
23.8	Rod. @ 30 cm scale		"		
2 #5					
23.7	Just under critical				

Conclusion Critical @ 23.75 cm on sight glass.

Sight glass	23.75
Zero correct	1.07
Bottom "	0.93
Critical height	25.75
vol.	13.05 V
Mass	4.90 Kg x
	4.68 Kg x
H/x	61.8

96 9/29/49

Experiment # 277 H/x ~~6.3~~ 6.1

Cronin 10" Al. Col. surrounded by one 1" OD 85% H_3PO_4

Fox Source & Instr. set up same as Exp # 273 : No other reflector

Kruesi

Murphy						
3^{15}	8.7	10.5, 11.5 (11.0)	(10.0) 9.5, 10.5	1.0	1.0	
3^{22}	16.1	26.0	24.0	.42	.42	H2 HIT @ 18.5
3^{25}	19.6	37.5	38.5	.29	.26	
3^{40}	24.0	75	89.5	.145	.11	
3^{46}	26.1	133	~~133~~ 162	.083	.062	
3^{58}	26.85	187	231	.059	.043	
4^{05}	27.85	323	415	.034	.024	Everything dying
	Readings in doubt. Drawn to 24.0 & starts up again.					
4^{10} (	27.9	354, 349,	443, 452	.031	.022	

Out of solution.

Extrapolation on enlarged scale shows extrapolation to 29.05

Examination of graph shows this value probably correct to ± 0.3 cm

Cu. in 10"

Drainbock - #3 10 cm.

#2 10. cm

#1 8 cm + D.V.

Conclusion: By extrapolation of above data critical height is estimated at 29.05 ± 0.30 cm.

Bright glass reading	29.05
Zero extent -	1.07
Bottom "	0.93
apprx critical height	31.05
vol	15.72 ✓
Mass	~~5.64~~ kg x
	563 kg x
H/x	61.8

NO.
10
10
NO.
12
12
14
14
16
16
NO.
10A
12A
14A
16A
17

6.3 62.1

85% H_3PO_4

the reflector

1.0
.42 42 MT @ 18.5
.26
.11
.062
.043
.025 Everything dry
.012

to 29.05
to + 0.3 cm

+ D.V.

critical height

$(BiO)_2CO_3$

Weights of ~~XXXXX~~ in shells

No. of shell	Tare	Gross	Net
10 A	9.5 lbs.	20 lbs.	10.5 lbs.
~~10 B~~	9.5	20	10.5
~~AAA~~			
~~AAB~~			
12 A	11.0	24	13
12 B	11.0	24	13
14 A	12.5	27	14.5
14 B	12.5	27	14.5
16 A	14.0	32+	18+
16 B	14.0	32.5	18.5

% Bi in $Bi_2O_2CO_3$ $\frac{418}{510} \times 100 = 82.1\ \%$

No. of shell	Cross section area	vol.	Density of $Bi_2O_2W_3$	Density of bismuth
10A + 10B	197 cm²	16,010	.596 g/cc	.488 g/cc
12A + 12B	233	18,120	.650 g/cc	.534 g/cc
14A + 14B	268.5	21,800 (21,148)	.603 g/cc	.495 (.502) g/cc
16A + 16B	301.8	24,500	.677 g/cc	.555 g/cc
			Av .631	.518
17A	309			

Exp. 278

9/~~28~~24/49 10" Al Cyl. H/X = ~~66.3~~ 67.1 4 shells $(Bi_2O_3)(CO_3)$ (No other reflector) ~~9/30/49~~ 9/28/49

Morfitt
Fox
Schuebe
Kruesi
Cronin

Source 15.5 cm on scale
Instruments = #4 - 6.2 on x200 } in trip circuit
#6 - 7 on x1000 }
#3 } indicating only
#5 }

Time	Sol'n Ht.	C_1	C_2	C_0/C_1	$\frac{C_0}{C_2}$
10:35	9.1	10.0	9.0	1	1
		10.0	9.0	1	1
10:57	14.6	18.0	16.0	.555	.56
	18.1	23.5	22.5	.426	.40
	22.0	34.0	35.5	.295	.253
	25.9	48.5	54.5	.206	.165
11:30	27.3	53.0	63.0	.189	.143

Morfitt
Fox
Kruesi
Cronin
Schuebe

~~X~~ 1

1:30
1:45
2:00
2:17

Conclusion: Not critical Out of solution. probably.

Critical height greater than 36cm. Untamped height for this H/X & cylinder diameter is unknown. Estimated critical height for Bi_2O_3 at some assay + H/X ≅ 34cm. Thus we can conclude that, under the conditions of the experiment, the poisoning effect of the nitrate is ~~this~~ greater ~~than~~ than ~~this~~ any reflection or moderating effect of the bismuth at this density. See p 97.

rod in tamper

2:40

$H_c > 36$ cm
$V_c > 18$ ℓ
$M_c > 6.4$ kg X
H/X 61.8

Concl

14/4

Dr

Exp 279

o other reflector)

~~9/30/49~~
9/28/49

10" Al cyl H/X = ~~663~~ 62.1 4 shells $Bi_2O_2CO_3$
with water reflector
Instrument + source setup same as Exp. 278

Morfitt
Fox
~~Kowarski~~
Cronin
Schmabe

Sol. Ht.	C_1	C_2	C/C_1	C/C_2
	6.0, 6.5 } when water tank first filled	{ 4.0, 4.5 }		
	5.5, 5.5 } 45 minutes later	{ 4.0, 4.0 }		
~~0~~ !	9.2	5.5	4.0	1	1
1:30	12.2	9.0	8.0	.612	.500
1:45	14.1	12.5	12.0	.440	.333
2:00	17.1	27.5	28.0	.200	.143 Stop from #2
2:17	19.1	133.5	145.0	.041	.028 Start from #3
rod in tamper		53	60	.014	.007
2:40	~~19.6~~	~~Critical~~ taper	Critical when rod at ~~3~~ 3		
	19.7	Critical at 31.5 sub. critical at 30			
	19.6	sub critical with rod out			

Conclusion Critical at about 19.65cm

Light glass height	19.65
Zero correct	1.22
Bottom "	0.93
Critical height	21.80 cm
	4
Vol.	11.05 ✓
Mass	3.96 Kg x
H/X →	61.8

drain back
Cmo in 10" cyl
#1 9cm + deadwood,
#2 8 cm
#3 10 cm

10/4 ~~Previous~~ done with 6" H2O top tamper - DC.

Experiment #280 #X = 67.1

9/29/49 10" Aluminum Cyl. #X = 66.3 t = 1" OD shells of 9/29/49

Cronin Fox Morfitt Schwarz

$UO_2(NO_3)_2$ solution, density ∞ 1.56; g U/g soln. =
(sampled on reg # . No other reflector.

Source 15.5 cm. Trip Point 0.7 on #6 coarse scale; #4 7X 200 (meter)

Time	Sch. Hgt.	C_1	C_2	C_0/C_1	C/C_2	Remarks
11:30	~~12.3~~	(8.0)	8.5			
lunch etc. → 12:20	9.0	8.0, 8.0	8.0, (8.5)	1.0	1.0	#1 MT @ 7.5
12:30	12.3	12.5	14.5	.64	.59	#2 flatten.
12:35	15.0	21.5	22.5	.37	.38	
12:40	17.3	37.5	44.0	.21	.19	#2 MT @ 17.9
12:50	19.0	73	85.5	.11	.10	
1:00	20.4	231	267	.035	.032	
1:07	21.0	Critical with rod @ 25.5 scale				
1:10	20.95	Slightly subcritical with rod all out.				

Cronin Fox Morfitt Schwarz

Time
1:45
1:52
1:58
2:06
2:12
2:18
2:19

Conclusion: Critical @ 20.95+ on sight glass.
Ĵ exp 26 t. Where same disposition of water gave 21.2 on sight glass.

~~sight glass~~	~~20.95~~	20.95 cm sight glass
Zero correct	~~1.02~~ 1.07	Zero correct
bottom correct	.93	bottom correct
critical height	~~22.95~~ 22.95	cm critical height
Vol	11.70	11.63 ℓ critical vol.
Mass.	4.20 Kg. x #/x	4.17 Kg. x. 61.8

.1

Exp # 281

Shells of 9/29/49 10" Aluminum Cyl H/x ~~66.3~~ 62.1 3-1" OD Shells

of $UO_2(NO_3)_2$ solution density ~ 1.56 g 21/prod.
No other reflector.

Source 15.5 cm. instruments as in Exp # 280

Remarks.	Time
	1:45
#1 MT @ 7.5"	1:52
#2 fission.	1:58
	2:06
#2 MT @ 17.9	2:12
	2:18
	2:19

Soln. H/l.	C_1	C_2	C/C_1	C/C_2	Remarks
8.9	(9.0) 8.5, 9.0,	(7.5) 7.5, 8.0	1.0	1.0	
13.0	14.5	12.5	.62	.60	
17.05	26.5	30.0	.3K	.25	#2 MT @ 16.3
19.6	58.5	70.0	.15	.11	
21.05	193.	260	.047	.029	

21.65 Critical with ~~rod~~ rod @ 29.5 cm
21.6 Subcritical with rod all out.

Conclusion: Critical at 21.6+ on ~~eight~~ glass

Zero correct.	1.07
Bottom correct	0.93
Critical height	23.60
V_c	~~H.90~~ 11.96 l
M_c	4.25 kg X –
H/x	61.8

ll out.

lass.

:2 on sight glass.

on sight glass
zero correct
bottom correct.

on critical height
critical vol.
V. : 2 cm

Exp 282

9/29/49

10" al cyl H/x - 62.1 66.3 2-1" OD shells of $UO_2(NO_3)_2$ Sol No other reflector

Other details same as in Exp 280 + 281

Cronin
Fox
Manfield
Schwarz

Time	Soln Hgt	C_1	C_2	δ_1	δ_2	Remarks
		(8.75)	(8.75)			
2:35	9.0	9.0, 8.5	8.5, 9.0	1.0	1.0	
2:46	17.0	26.5	28	.34	.31	
2:54	19.4	43.	50	.20	.17	#2 HT @ 18.1
3:00	21.8	103	138	.085	.065	est crit 23.4
3:14	23.2	Too high to count. Est critical 23.3				
3:16	23.35	Critical with HT @ 28 cm				

Conclusion: Critical @ 23.3 cm on sight glass.

sight glass 23.3
glass correct 1.07
bottom correct .93
corrected height 25.30 cm
critical vol 12.87 l.
critical mass 4.60 kg X
H/X 61.8

9/29/49

Cronin
Fox
Manfield
Schwarz

Time

3:30
3:43
3:50
3:56
4:02
4 25

Dunbar
4 29

Co
estimated

Experiment 283

OD shells

281

Remarks.

#2 MT @ 18.1

est. cr. 23.4

23.3

light glass.

9/29/49

10" Al cyl. 4/X = ~~66.3~~ 62.1 1-1" OD shells of $UO_2(NO_3)_2$ sol. FOR details see exp. 280 & 281

Crowell
Fox
Manfredi
Schwake.

Time	Soln Hgt.	C_1 (4.75 Al)	C_2 (8.75 Al)	C/C_1	C/C_2	
3:30	9.0	8.5, 9.0	8.5, 9.0	1.0	1.0	
3:43	18.7	25.5, 26.5	~~26~~ 31.5	.34	.28	#2 MT
3:50	22.0	41	54	.22	.16	
3:56	24.1	66.5	89	.13	.10	
4:02	26.15	135	204	.064	.043	
4 25	27.7 *	887	729	.009	.012	

* All lines blown dry. #1-9 except #5. #4 Leaks.

Drumbaugh
4 28

~~26.9~~ 26.8 264 414 .033 .022

Conclusion: By extrapolation critical height is estimated from the graph as lying between 27.8 & 28.0

Critical at 27.9 ± 0.1 cm [EXT from 27.7] in sight glass.

sight glass	27.9	
Zero correction	1.07	
bottom correction	0.93	
Corrected height	29.90	cm
critical volume	15.1 ~~X~~	l
critical mass	5.4 ~~3~~	Kg X
H/X	61.8	

Experiment 284

9/30/49

10" Al cyl. with 1 1"-OD Shell water. No other reflector. H/X = ~~6.3~~ 6.1

Source at 15.5 scale. Trip points 6×200 (meter) on #4 7×1000 on #6; Plate Mult. 0.c.

Cronin
Fox
Morfitt
Schwake

#1 MT@ 7.0
#2.

Time	Soln. Ht.	C_1	C_2	C/C_1	C/C_2	Remarks
8:50	9.3	7.0, 8.5 (8.75 Ave.)	10.5, 12.0 (11.0 ave)	1.0		
9:10	16.9	26.0	32.0	.35	.34	
9:16	19.2	35.0	46.0	.25	.24	#2 MT@ 18.3
9:20	23.0	77.5	109.5	.114	.101	Cyl #1, 2, 4, 6-9 Blown dry.
9:29	25.0	178.5	259	.049	.042	
9:35	25.8	351	514	.025	.021	
9:43	26.8 Super critical at		with rod at 29.5			
		Critical	" "	28.0		
9:46	26.65	critical with rod out				
	1.07	26.6 sub-critical				
	0.93					

Hc 28.65
Vc 14.51
Mc 5.20 kg. x ✓
H/X 61.8

Conclusion: Critical at 26.65

9/30/49

Cronin
Fox
Morfitt
Schwake

Time	
9:58	
10:05	
10:20	
10:30	
10:37	
10:45	
10:46	

Hc
Vc
Mc
H

Exp 285

10" al cyl with 2 1"-OD shells of water
No other reflector
Other details same as in Exp. 284
H/X = 6 2.1

9/30/49
Cronin
Fox
Morfitt
Schuche

Time	Sol Ht.	C_1	C_2	C/C_1	C/C_2
9:58	9.2	9.5, 9.0 (9.25 Ave)	8.5, 8.0 (8.25)	1.0	1.0
10:05	16.2	25.5	25.0	.36	.33
10:20	18.1	37.0	38.5	.25	.215
10:30	21.6	172.0	220.5	.054	.037
10:37	22.35	618.0	814.0	.015	.010
	Rod in	212.	267	.044	.031
10.45	22.65 Rod at 29.0 Supercritical			(1.15 cm rod)	
	Rod at 27.0 Subcritical			(1.15 cm rod)	
10.46	22.60 Subcritical with no rod				

Conclusion: Critical at 22.60

22.60
1.07
.93
H_c 24.60
V_c 12.46 V
M_c ~~4.46~~ kg X V 4.47 kg X
H/X 61.8

	No	other
(meter) on #4		
	#1 MT@ 7.0	
	#2.	
C/C_2	Remark.	
.34		
.24	#2 MT@ 18.3	
.101	Cyl #1, 2, 4, 6-9 blown dry.	
.042		
.021		
al at 26.65		

Experiment 286

9/30/49

Cronin
Fox
Morfitt
Schuske
Henry

10" al. cyl. with 3 - 1" OD shells of water
No other reflector H/X = 66.3 ~~6~~ 1
Other details same as in 284

Time	Sol. Ht.	C_1	C_2	C/C_1	C/C_2	Remarks
10:54	9.0	8.5	6.5	1.0	1.0	
		8.5	6.5			
11:11	16.0	22.0	21.0	.386	.309	
11:17	19.0	52.0	56.5	.163	.115	
11:25	21.0	299.0	360.0	.028	.018	
11:35	21.5	Sol crit. with rod at 25.0 on scale.				(4.0 cm rod)
11:37	21.4	" " " " " 26.5 " "				(3.5 " ")
11:38	21.3	Not critical (no rod)				

Conclusion: Critical at 21.35

~~21.35~~
~~1.07~~
~~.93~~

H_c = ~~23.35~~ cm. Calc. by Schuske
V_c = ~~11.83~~ l
M_c = ~~kg~~ X ~~4.~~ kg X

Written by Henry Mark by Morfitt

21.35
1.07
.93

H_c = 23.35
V_c = 11.83 ✓
M_c = 4.24 kg X ✓
H/X 61.8

9/30/49

Cronin
Fox
Morfitt
Schuske
Henry

10

Time
11:3
11:3
12:0
12:1
12:1
12:2

H_c =
V_c =
M_c

dn
dn
dn

Experiment 287

9/30/49 10" Al. cyl. with 4 - 1" OD shells of water
Cronin . . No other reflector H/X = ~~66.3~~ 62.1
Fox
Morfitt Other details same as in I 84
Schuske (Check on Exp. 264-264B, but with different shells; these are the ones used for H_3PO_4
Henry

Time	Sol. Ht.	C_1	C_2	C/C_1	C/C_2	Remarks
11:52	9.0	8.0	6.0			
11:57	17.1	24.0	21.0	.333	.286	
12:05	20.0	90.0	100.5	.089	.060	
12:13	20.7	364.0	441.0	.022	.014	
12:18	21.05	Critical with rod at 23.05 cm.				(5.5 cm rod)
12:20	20.9	" with " " 29.0 "				(rod out)

Conclusion: Critical at 20.90 cm

20.9
1.07
.93
H_c = 22.90
V_c = 11.60 l ✓
M_c = 4.16 kg X ✓

H/X 61.8

Inventory Drain Back:

Dn #3, 10 cm. (Drain Ø 18.1 from reactor as seen on sightglass)
Dn #2, 18.6 cm " " 7.5 " " " " " " "
Dn #1, 7.5 cm from reactor + DV.

108

Macklin

10/4/49. Exp 288

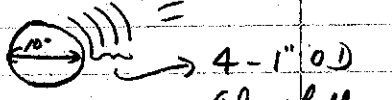
10/5/49

For Cronin

10" al reactor, H/X = ~~66~~ 62.1

For Cronin Callihan

MIXED TAMPER: ⟶



PURPOSE: To examine effect on C.M. of introducing layer of air between reactor and tamper water

Sphere Submerged in H_2O
6" Hi-top tamper.

TRIP PTS - ~~#4 × 200~~ #4 6.2 × 200 } Watts reading
#6 7 × 100
~~#7~~ Out -

Instrument Scales #3 × 10, #4 × 100, #5 × 1, 6 × 25

Source at 15.5 cm on scale ≡ 8 cm from 6 × 6 cm

2:20		Start filling for #1.				
:35		6.5 cm	#1 empty;	Filling for #2.		
:40			#1	#2		
:41	9.1		4.0	5.0		
			5.0	5.0		
			4.5	5.0		
:50	12.1		6.0	8.5	0.75	0.59
3:00	14.4		8.0	13.5	0.56	0.37
:12	17.0		13.5	25.5	0.33	0.196
:32	18.9		24.0	44.5	0.19	0.11
:35	20.8		131	2260	0.03	0.02
:42	21.2	Sub critical, rod out.				
	21.35					
:50	21.45	CRITICAL ROD 3.5 cm in solution.				

Stop filling #2; filling #3

INVENTORY

~~3~~ 3 10.1 cm in 10" reactor
~~2~~ 2 11.9 " " " "
~~1~~ 1 5 " " " " + D.V.

CRITICAL WITH SIGHT GLASS RDG = 21.4 cm.
1.22
.93
Hc = 23.65
Vc = 11.93
Mc = 4.28 kg
H/X 61.8

(FULLY TAMPED H = 14.5 cm

10/5/49

Fox
Cronin

Dilution to H/X 200

Maximum volume needed to become critical in 15" cyl (unstamped) (from part III Crit Mass) is 19.8 Liters ≅ 2.3 Kg X
Therefore 5 Kg of X should be ample for nitrate.

Present Inventory = 6,445 Kgm of U Casing .248 g/gm as analyzed
needed 5,000
1,445 Kgm excess

equivalent to $\frac{1,445}{1.55 + .248}$ = 3.755 Liters ≅ ~~7.33~~ 7.43 cm in 10" cyl
g/l g/cc g/cc

However in cyl E = approx 225 gms of U ≅ ~~1.44~~ 1.16 cm in 10" cyl (of conc. fuel)

total excess solution = ~~1.444 + 7.33~~ 7.43 + 1.16 = ~~8.47~~ 8.59 cm in 10" cyl
to be put aside for future use.

Remainder = 13.008 Liters − 0.585 L = 12.423 Liters
to distribute in 7 cyl = 1.773 Liters per cyl.
≅ 3.5 / cm

$\left(\frac{H}{X}\right)_1 - \left(\frac{H}{X}\right)_2 = \left(\frac{gm\ H_2O}{gm\ UO_2(NO_3)_2}\right)_1 - \left(\frac{gm\ H_2O}{gm\ UO_2(NO_3)_2}\right)_2 \left(\frac{391.15 \times .934}{\Delta\ 9}\right)$

gms $UO_2(NO_3)_2 \times .6012$ = gms U

Δ gms H_2O = $\Delta\left(\frac{H}{X}\right)$ gms U × ~~.004092~~ .0358

Δ gms H_2O = (200 − 66.3) (5000) × ~~.004092~~

.932 × 9 / 391 × .601 = .533 ?

= 35.52 Liters to be added
minus (~~5.671~~ (to compensate for E) + 5,671 cc in E)
~~5.671~~
Net = ~~21.849~~ Liters of water to add = 29.849

Suggest Procedure:
into cyl K = 8.47 cm from 10" cyl and detach from line.
into C, D, F, G put ~~3.45~~ 3.5 cm from 10" cyl
in A+B put remainder + dead Volume. 29.849
Then - into 10" cyl empty Cyl E and add ~~21.849~~ Liters water
to 10" cyl. mix well & drain back into each of 10.1
Cyl C, D, F, G, 5.074 Liters = ~~7.949~~ cm in ~~cyl (E)~~ ~~7.949~~ cm in 10" cyl
Then divide remainder between A+B mixing well.

→ 4-1" OD al shells empty (Assume) H2O = ... in H2O

Stop filling #2; Filling #3.

FULLY TAMPED H = 14.5 cm

10/5/49

Cronin

For Morfitt

Exp 289 10" Al reactor H/X = ~~66.3~~ 62.1

Reactor surrounded by 3 1" OD empty shells Rest of tank & shells filled with H_2O also top tamper. Trip Point #4 6x200 (meh) #6, 7x1000 (meh). Source @ 15.5 on scale.

Time	Soln Ht.	C.	C_m (5.0)	Δk	$\Delta k/hr$	Remarks
2:22	9.0	4.0, (4.0)	5.5, 4.5	1.0	1.0	#1 HT @ #9
2:29	14.0	7.0	10.5	.57	.57	from #2
2:36	18.0	21.5	35	.14	.14	#2 N.T. @ 17.4
2:43	19.2	46.0	82	.087	.061	Est. cr. 20.3
2:52	20.4	Critical with Rod @ 20 on scale.				
2:56	20.2	Subcritical. About as much "sub" as previous one was "super"				

Time: 10/5/49

Conclusion: Critical with eight glass @ 20.3 cm

20.3
1.22
.93
Corrected Ht 22.45

Vc 11.37 l

M C 4.08 Kgm.

H/X 61.8

Calc. of H/X taking into acct. free HNO_3:

Analysis: gm U/gm = .09668 av.

Previous H/X data: $\frac{U}{H(\sim HNO_3)}$ = 360, or .00278 gm H/gm U

In 100 gm sol, gm $UO_2(NO_3)$ = $9.668 \times \frac{391}{235}$ = 16.1 gm.

~~From previous H/X data $\frac{N}{U} = \frac{3.92}{24.8} = .158$~~

gm free H = $9.668 \times .00278 = .0269$

" " HNO_3 = $6.3 \times .0269 = 1.69$ gm.

gm H_2O/100 gm = $100 - 9.668 - 1.69 = 82.22$

gm H_2 = $\frac{82.22}{9} = 9.14$

Total H = free H ($\sim HNO_3$) $.0269 + 9.14 = 9.17$

H/X

10/5/49

Exp 290 10" Al reactor H/X 6636 2.1

Rest of Tank
Trip Points

Crowe
Fox
Moffitt

Reactor surrounded by 2 1" OD safety shells. Rest of tank & shells filled with H_2O also top tamper used. Trip Points & Source setting same as 289.

Soln. Ht.	C_1 (2.75)	C_2 (5.5)	1/M.	1/M	Remarks	Time
8.5	2.5, 3.0		1.0	1.0		
14.1	6.0	11.0	.46	.32	from #2	
16.8	15.0	31.	.185	.113	Stopped #2	
18.0	37.	74	.074	.047	from #3 Est crit 18.85 cm	

~~18.9~~ 18.85 just slightly super critical with rod out
18.8. Subcritical with rod out.

Conclusion: Critical with eight glass @ 18.8 cm.

18.8
.93
1.22
Corrected Ht. 20.95

Vc 10.61
Mc 3.81 Kg
H/X 61.8

$$H/X = \frac{9.17}{9.668 \times .933} \times 23 = 239$$

1/5/49

Cronin — Exp 291 — 10" Al reactor — H/X 62.1 ~~66.3~~ — 10/6/49

Fox
Morfitt

~~Rotor~~ Reactor Surrounded by One 1"OD shell Removing shells, Stand & top tamper filled with H_2O. Source & instrument same as #289.

Time	Soln Ht.	C_1	C_2	$1/M_1$	$1/M_2$	
3.50	9.0	2.5	3.5	1.0	1.0	
3:56	14.0	6.5	13.5	.39	.26	
4:02	15.8	19.0	40.	.13	.088	Est α_1 6.7
4:15	16.8	Subcritical. ← This closer to critical than pt. below				
4:17	16.95	Supercritical				

Conclusion: Critical with eight glass at 16.85 cm.

READY TO DILUTE

SEE PAGE 109 & 110

16.85
.93
1.22
Corrected Ht 19.00 cm ✓
Vol. 9.63 ℓ ✓
Mc 3.45 Kg ✓
H/X 61.8

10:02 AM

10:06

11:52
11:59
~~12:02~~

12:10

12:20

In
#
#6
#
Proce
Sour

Red
Valv
turne

#1
0
#2
Ht =

into #

Ht. H
in #7 14
3

62.1
66.3

10/6/49

Dilution to 4/+ 200

hell Remaining

For Cronin

urce &

-6

)88 Est 9.7 K.7

e than pt. below.

5.85 Cm.

'D

Into Cyl K = 8.59 cm
" Cyl G = 3.51 "
" " F = 3.51 "
" " D = 3.51 "
" " C = 3.51 "
" " A = Remainder
" " B = + Dead Vol.

Empty Cyl E into 10" Cyl and add 29.849 Liters of DD water.

Drain water from:
Cyl. G = 10.1
F = 10.1
D = 10.1
C = 10.1
B = } remainder
A = } + Dead Vol.

10:02 AM Instruments checked check List covered.
#4 } on trip circuit #4 at 6 x 200
#6 } at 7 x 1000
#3 on sensitive scale
Process Monitor on.
Source in operating Position Top Tamper } Removed and emptied
Shells }

10:06 Red light ON
Valve on Cyl. E was not completely closed - as air pressure turned on - sprayed pit. pit was cleaned out.

11:52 #1 Cyl MT Background at 9cm (Source covered)
11:59 ∅ #1 - 7.0 #2 5.0
12:02 #2 Cyl MT
Ht = 20.1
12.08
Lost approx ½ of E ∴ ½ x 1.14 = .57cm
8.02 cm into K (To allow for E loss.
12:10 into #2 = 8.02 cyl K.

12:20 Ht. 18.40
- 14.80
3.60 into G

10/7

Fox

12:25 into 6 14.80
11.20
cyl F 3-60

Henry
Beny
Cronin

Cyl E
Previ
add

12:30 Red Light off - Lunch.

1:00 ~~Red light~~ on

1:05 into D 3.59cm

1:12 into C 3.59cm

1:15 into H 3.59cm

1:25 into A remainder = DV + 0.4cm.

U in

all
Some
Solut

5:00 all cylinders have been removed, washed, + covered with new paper — pit rinsed out again
Cylinders now on manifold!

1:15

In
#
#

A	DV + 0.4 cm
B	MT
C	3.59 cm
D	3.59 cm
E	? of dilute washings.
F	3.59 cm
G	3.59 cm
H	3.59 cm
J	MT

1:17

1:25

Water
58

into c

1:35

1:40

1:45

1:55

into cy

into cy

into cy

counte

not connected to manifold.

{Cyl K - contains 8.02 cm of 4/4 66:3 (10" cm)
{Cyl L - has material from X-12

Area in front of Pit, and Pit lip and top should be surveyed in morning to check for hot spots.

Wash material and pit rinsing together as Run 10.

DH.

Drain
filling

2:15
2:17

2:25
2:43
3:09

Cyl D-M
Cyl B ½ M
Cyl B MT
wt. 31.6
31.6

10/7 Dilution (cont)

Fox
Henry
Berg
Cronin

Cyl E in dead vol to gasket (3") = 15" of 3" pipe = 1.73 Litres
Previous vol = 5.6 Litres = so roughly $\frac{1}{3}$ vol remaining.
Add to water 3.99 Litres

29.849
33.789 L total needed.

U in Cyl = 68-6 gms approx (which neglect for dilution.

12:10 all water added to Reactor
Some drained by mistake into D (.
Solution mixed by air sparging until

1:15 Instruments on
#4 6×200 } in trip circuit
#6 7×1000 }
#3 on sensitive scale
PM on.

	Water ht.	#1	#2
1:17	58.3	9.5	14.0
1:25	into cyl H	57.1	
		47.0	
		10.1 cm of water	
1:35	into cyl G	47.0	
		36.9	
		10.1 cm of water	
1:40	into cyl F	10.1 cm of water	
1:45	into cyl C	10.1 cm of water	

1:55 counting background at 16.7 cm ht (water)
#1 9.0 #2 10.5

Drain to 6.6 in cyl B
filling from A to mix.

		#1	#2	$\frac{1}{M_1}$	$\frac{1}{M_2}$
2:15		11.0	23	.864	.61
2:17	cyl D-MT.	14	37	.68	.378
2:25	cyl B ½ MT	18.5	64	.514	.227
2:43	cyl B MT	18	57	.50	.185
3:09	ht. 31.6	20.5	85.0	.439	.123

31.6 after slowback

dilution (cont'd)

3:15

Solution Inventory

A = 5.6 + DV
B = 13.0 cm
C = 13.5cm
D = 13.0cm
E = MT
F = 13.5cm
G = 13.6cm
H = 13.5cm

A, B and D were mixed by air until sight glass reading remained constant after blowback.
C, F, G, H mixed by pulling air thru solution line with vac. pump.

DK

Sp. Gr. = 1.162
gms U/gm = .0970
gms X/gm = .0905
gmX/cc = .1052

Cronin
Callihan
Benz
Fox
Henry

Trip

Part A —

10:18	7.
10:25	of H
10:26	
	HT.
	9.3
after blow back	9.3
	21.
	21.3
blowback	21.3
11 cc	24.0
Callihan Out	
11:06	32.4
11:16	35.5
Henry in after 11:29 blowback	35.6
	28.9
	22.9
11:38	16.9
11 42	22.9
12:00	28.9
1st blowback	29.2
2nd blowback	29.2
1:25	35.2
1st blow	35.3
2nd blow	35.3
1:35	29.3
1:35	35.35
	35.5
1:42	35.5
Callihan In.	
	42.7
	42.3

Cronin
Callihan
Benzy
Fox
Henry

Expt. 292 (Oct 9?) 9/10/44

H/X = 200 10" Al Reactor — Untamped

Trippoint on #4 5.8 on 200 scale; source 8 cm (=15.5 in scale

Inst. Scales #3 - 100; #4 - 10; #5 - 2 scale; #6 - 25

Part A — Preliminary Mixing

10:12 Filling from H
10:25 of H-MT sight glass 6.8 cm (with air in line)
10:26

	Ht.	cyl.	#1		#2	#1	#2
sight glass	9.3	G	8.0	7.5	10.0		
after blow back	9.3		7.0		10.0		
solution	21.5	G MT 1 cm from F					
	21.3						
blowback	21.3		12.0		35.0	.625	.286
			12.0		37.0		
11 cc	24.0	from F	13.5		40.0	.556	.250
Callihan Out							
11:06	32.4	From F	18.0		66.0	.415	.152
		F (empty)					
11:16	35.5	From C	20.0		81.0	.375	.1235
Henry in after blowback 11:29	35.6		20.0		80.1	.375	.1245
	28.9	Drain To E 6.9 cm					
	22.9	Drain To F 6.0 Cm					
11:38	16.9	Drain To G 6.0 Cm					
11 ~~42~~	22.9	Fill from C 6.0 cm. — Same after mixing					
12:00	28.9	" " B 6.0 " "					
1st blowback	29.2						
2nd blowback	29.2						
1:25	35.2	from B	20.0		73.5		
1st blow	35.3						
2nd blow	35.3						
1:35	29.3	into B					
1:38	35.35	from A	~~[illegible]~~				
	35.5						
1:42	35.5		19.5		74.5	0.38	0.13
Callihan In.							

Fillings from D.

42.2 Rod On -
42.3 After blow back then sight glass.

10/10/49.

Exp 292 (cont) 10" al unflanged H/K = 200 = 243

	H	I (7.5")	II (100)	I	II	
	42.1 cm	23.5	104	0.32	~~7.0~~ 0.0	
	47.8 - Rod dn.					
2:13	47.9 " " after blow out.					
2:16	47.7	~~28.~~ 29.0	132	0.26	0.08	
2:23.	48.9 Rod dn.					D Empty. Filling A
2:29	54.9 Rod dn					
	55.2 - " " After blow back					A Empty.
2:33	54.9 Rod out	~~34~~0	189	0.19	0.05	Filling from B.
2:42	61.9 Rod dn					
2:45	62.0 " " after blow back.					
:52	61.6 Rod out	64.0	323	0.12	0.03	B empty, fillng from C
3:02	68.2 Rod dn.					C Empty.
:05	67.8 " " after mixing.					
:21	67.4 Rod out	166	858	0.05	0.01	
:31	72.5 Rod dn					from E
36	72.3 " " after mixing.					
:42	72.0 Rod at 58.0 from bottom Super Critical (sub critical at 57.5)					
	71.9 (corrected for rod displacement					
	71.7 71.6 corrected Super Critical (Rod at 58.5) sub at 58.0					
	71.2 Rod at 61.5 Super critical sub at 60					
	71.1 corrected					
3:50	70.6 Rod at 66 supercritical sub at 65					
	70.1 Sub Critical Rod out.					

Critical at 70.35 ± .25 cm

Drainback:

G =	13.1 cm	70.35	
F =	13.0	1.07	
E =	13.6	.93	
D =	13.0	H_c = 72.35	
C =	13.5	V_c = 36.65	
B =	13.5 ?	M_c = ~~3.85 Kg~~	~~3.83 Kg~~ 3.82 Kg
A =	5.6 + DV	~~3.84~~	H/K 240

10/12/49

Benz
Crown
~~Collins~~
Fox
Morfitt

Time	Ht.
2:29	9.1"
2:42	13.0
2:49	~~14.0~~
3:00	18.2
3:06	18.6
3:11	18.3

H/K ≈ 200

=243

10/12/49

Benz

Crowe

~~Exhibition~~

Fox

Morfitt

H/K ≈ 200

Exp 293 10" Al reactor. Completing Wts Tamped

Source @ 16.5 cm scale. Trip Pois ✓ #2 Counts N.G.

tube in scaler & discrim. ok. Turned & condenser in pre-amp. All others ok

Time.	Ht.	#1 (2.62 Av.)	#M.	Remarks.
2:29	9.1 ✓	2.75 2.50	1.0	#1 MT, @ ≈ 6.0 from #2.
2:42	13.0	4.5	.58	
D Empty. Filling A 2:49	~~15.0~~ 17.0	18.0	.145	Stopped from #2 from #3
3:00	18.2	211.5	.012	
A Empty. 3:06	18.6 cm with rodin.	Critical with rod @ ~~25~~ 26 cm scale.		18.5 cm with rod out.
Filling from B. 3:11	18.3 cm with rod out.	Now - critical		

Conclusion Critical @ 18.4 cm ne slightly low.

Drainback as per exp 292.

	18.4
	1.22
	.193
H_c =	20.55
V_c =	10.41
M_c =	~~1.092~~ kg 1.09 kg
	~~H/K 240~~ H/K 240

B Empty. Drillings from C

C Empty.

from E

cal 2857.5)

) sub 2858.0

sub 2860

3.82 kg

· 240

Monday
10/12/49

Ex 294

10" Al Reactor 20 sheets of Stainless (2½") + Complete Water ~~Pumped~~ Reflector

H/K n 243

Source at ~~6cm~~ (3.5 ~~5cm~~ on scale)
Lowered to 6 cm n/105

Instrument	Trip Point
#3	90 x100
#4	6 x 200 (on meter)
#5	none
#6	4.5 x1000
#7	3" from PM tube
Process Monitor	none

Inst Berry
Safety Henry
S.C. Fox
Book Macklin
Supvr Callihan

Hc =
Ve =
Mc =

Inventory Cyl / cm in 10" cyl. Ht.	#1	#2	#3	#4	#5	#6	#7	#8	#9
	DV+5.6cm	13.5	13.5	13.0	13.6	13.0	13.1	—	—

Time — ~~Ht~~ — #1 — #2 — $\frac{1}{PM_1}$, $\frac{1}{PM_2}$

11⁰⁷ #Acyl ~~D~~ empty

11¹¹ #A empty. ~~Start~~ #B toward 7cm on S.6.

11¹⁴ at 7cm Taking Bkg - Rod out Tamper down

11¹⁵ 6.9 {8 {2.5 {8 {3

11²⁷ Rod in, filling to 12 out of B (effect B empty n 18.9)

11³² Rod out, Tamper down std. Count

12.0	13	7	.62	.39

11³⁸ Rod in - B to 14½

11⁴⁴ Tamper down, Rod out Count.

14.5	23	13	.35	.21

11⁵⁰ Rod in Fill to 16½ from B

11⁵³ Tamper down Rod out Tamper has little effect compared with control rod (full width?) Count

16.5	45.5	29.5	.175	.093

12⁰¹ Rod in To Fill to 17.8 from C Tamper observed to be full

12⁰⁸ air off, Tamper down, Rod out #5 scale 2 Count

17.8	168.5	120	.0475	.023

12¹⁸ Rod in to 18.3 out of C

12²⁰ Tamper down Rod out slowly Critical with C Rod 8.8 cm into Tamper
18.3

12²⁸ 18.1 (drained to C) Way Subcritical Rod out

12³¹ Drain to 16.5 into C ✓
" " 9.0 into B
~~Rod~~ off for lunch

Scale Scales
3 on 10
4 on 100
5 on 1
6 on 25

Conclusion
Critical at
18.25 ± 0.05
on sight glass

(over)

etc. Water
of Reflector

of Berry
Lawrence
Fox
Macklin
Callihan

18.25
1.22
.93
H_c = 20.40 cm
V_c = 10.33 Liters ✓
M_c = ~~1.085~~ kg 1.08 kg.
~~1.09~~ H/x 240

bad (built?) Count

be full

into Tamper

nclusion
itical at
7.25 ± 0.05
sight glass

10/17/49

Exp 295

10" Al. Reactor - 20 sheets of stainless ($2\frac{1}{2}$") - No water tamper

Callihan
Fox
Cronin
Benz
Macklin
Henry

Other data and conditions same as # 294

	Ht.	C_1	C_2	$\frac{C_{10}}{C_1}$	$\frac{C_{20}}{C_2}$
2.000	9.4	8 } 7.75	17.5 } 17.75		
		7.5 }	18.0 }	1.00	1.00
		Fill from B			
2:09	15.0	15.5	34.0	.500	.524
2:15 PM	18.8	22.0	51.5	.352	.345
		Fill from C			
2:24 PM	22.1	62.0	138.0	.125	.129
2:33 "	23.0	91.0	214.5	.085	.083
2:49 "	24.1	257.0	597.0	.030	.030
2:54	24.7	Subcritical with rod out.			
3:00	24.9	~~Sub~~Critical with rod at 29.5 (3.9 cm in solution).			

Conclusion: Critical at 24.8 ± 0.05 cm.

Drain TC to 18.0 on ~~sight~~ glass
Drain B to 5.5 " " "
" A to

24.8
1.07
93

H_c = 26.80 cm
V_c = 13.58 liters ✓
M_c = ~~1.428 Kg~~ 1.42 Kg.
~~+.43~~

H/x 240

10/18/49

Callihan
Fox
Macklin
Benz
Cronin

Inventory

Time
10:45

10:55
11:15
11:23
11:32
11:40
11:50
11:57

10

Sou
In
#
#
5
6
Pho
Cyl
5:5

Chec

Sol'n
7.3

12.
16.
18.5
19.5
20.4
20.65

Drain

Ex 296

— No water tamper

10/18/49 — 10" Al Reactor 1" of Stainless shell — Completely water tamped — H/X # 243

Callihan
For
Macklin
Benz
Cronin

Source at 6.0 cm (13.5 cm on scale)

Instrument	Trip point	Starting scale
#3	95 x100	x10
#4	50 x200	x100
#5	none	x1
#6	7 x1000	x25
Photo M	3" from tube	—

Cyl #	2	3	4	5	6	7	8	9
Inventory 5.5 cm +D.V	13.5	13.5	13.0	13.6	13.0	13.1	MT	MT

Time	Sol'n Ht.	#1	#2	C_o/C_1	C_o/C_2	
10:45	Check List ok Red light on					
10:55	7.3 cm	3.0	2.5			#1 MT at 5.7 filling from 2
		7.5 {7.5, ~~7.5~~}	{3.0, 3.5} 3.25			Counters moved.
11:15	12.1	12.0	6.5	.625	.500	
11:23	16.0	20.5	14.0	.365	.232	
11:32	18.5	44.5	37.5	.168	.087	Stopped #2 started #3
11:40	19.5	87.0	78.5	.086	.042	From 3
11:50	20.4	Sub critical with Rod out.				
11:57	~~20.65~~ 20.7	Critical with Rod 4 cm in.				

System critical at 20.6 ± 0.1 cm

Drain back

#3	~~18.5~~	13.5 cm
#2	~~5.6~~	12.9 cm
#1	5.6 + D.V	

20.6
1.22
.93
H_c = 22.75
Vol = 11.53 liters ✓
M_c = ~~1.21 Kg~~ 1.20 Kg. ✓
H/X 240

Expt 297 #/x 2 248

Macklin
Cronin
Fox

10" Al Reactor – 8 sheets S.S. equiv. to 1"
no Water Reflector – top tamper at top L. Sw.
9 nat. scale: #5-1; #3-10 #4-100; #6-25
source at 13.5 on scale
Drop pentaer in 296

Rel #t.	C_1	C_2	C_0/C_1	C_0/C_2
7.5 cm	6.5 } 6.25	11.0 } 11.25		
"	6.0 }	11.5 }		

1:00 PM	Red light on						
1:05 PM	18.0	15.5	29.5	.406	.390		
1:10	21.1 using 6 cm from 3					#2 cyl MT	
1:15	23.0	28.0	59.0	.223	.195	from #3 cyl	
1:20	26.1	48.0	101.5	.139	.11		
1:26	29.1	124	~~29~~ 297	.05	.04		
1:40	30.0	268	640	.025	.018	Stub #4 cyl	
1:50	30.8	Sub critical Rod out.					
1:59	30.9	Critical with 4 cm Rod In					

Cronin For Monfit	10
	ref kc
9:24	Red
Time	So
9:37	9
9:45	14.
9:50	17.8
10:08	19.5
10:15	20.4
10:26	21.2
10:45	21.8
10:50	21.6
10:52	21.4

System Critical at 30.85 ± .05 cm

Drainback
#4 ~~to~~ 30.0
#3 ~~to~~ 20.5
#2 ~~to~~ 5.5
#1 DV + 5.5

30.85
1.07
.93
Hc = 32.85
Vc = 16.6 ~~4~~ liters ✓
Mc = ~~1.755 kg~~ 1.73 kg ✓
H/x 240

#1	2	3	4	5	6	7	8	9
DV+5.5	13.5	13.5	13.0	13.6	13.0	13.1	—	—

2 4B

Cromi
For
Murfitt

Exp. 298 H/X ≈ 243

10/20/49

v to 1"

10" Al Reactor 4 sheets stainless steel egeni. & 1/2" reflector; - Top tamper, bottom, side tamping with wate

surrounded by wate

Tamper at top L. Sw.

; #e-25

Instrument #	Trips at.	Start at.
3	95×100	×100
4	5×200	×10
5	—	×1
6	6×1000	×25
7		
8 (Plate Mult)	3"	—

C_0/C_2

.390		9:24	Red Light ON				
	#2 cyl MT	Time	Sola. Kff.	C_1	C_2	C_0/C_1	C_0/C_2	Remarks
.195	from #3 cyl	9:37	7.0	7.0	3.0			#1 MT
.11				7.5	2.5			#2 "
.04		9:45	14.3	~~12~~ 11.0	6.5	.682	.462	From #2
.018	Stand #4 cyl	9:50	17.8	22.5	17.0	.333	.176	Stopped from #2
		10:08	19.5	40.5	31.5	.185	.095	From #3
		10:15	20.4	76.5	66.0	.098	.046	
		10:26	21.2	304	276	.025	.019	
		10:45	21.~~8~~9	Super critical		Rod 3 cm in		
		10:50	21.6	"	"	Rod in tamper		
		10:52	21.4	Sub Critical		Rod out		

Critical at 21.5 ± 0.1 cm

1.22

.95

H_c = 23.65 cm

V_c = ~~1498~~ ~~# 120 ft.~~ 11.96 ✓

M_c = ~~12.57~~ Kg 1.25 kg.

~~1.26~~ H/X 240

10/20/48

Ex 299

Morfitt
Fox
Cronin

H/X=242 10" cyl ½" Steinless no other tamper

Instrument same as #298
Source at 20.5

Solution	#1	#2	#3	#4	#5	#6	#7
	MT	2.2	13.5	13.0	13.6	13.0	13.1

~~Solution~~

Time	Sol'n Ht	#1	#2	$C_y/_{\#1}$	$C_y/_{\#2}$	
11:09	14.3	(8) 8½ 7.¾, 8¼	(5) 14.0, 14.5			
11:25	25.05	32.5	58.	.246	.260	H2 MT at 21.0
11:35	29.0	53.0	104.5	.151	.143	from #3
11:45	31.9	87.0	182.0	.092	.082	#3 MTab 333 cm
11:53	36.0	350	757	.023	.0198	from [redacted] #6
12:05	37.0	Sub Critical				Dr. Callihan
12:10	37.6	Super critical				
12:12	37.4.	Sub critical				

Critical at 37.5 ±1mm
1.07
.93
Hc = 39.50
Ve = 20.0 Liters V
~~Isotope~~
Mc = ~~2.105~~ Kg 2.09 Kg
~~2.11~~ H/X 240

#6 #3
13.4cm 13.4

Time	Sol'n
2:25	14.0
2:32	17.:
2:42	19.4
2:50	20.55
2:59	20.5
3:05	21.:
3:10	21.1

Cor

Dra

10/20/48

Ozone
Monfett
Fox

10/20/49

Ex 300

H/X = 242 10" Cyl. 1/4" Stainless water reflector

Source at 6 cm
Instruments same as #298 #299

Time	Sol'n Ht	#1	#2	$C_1/\#1$	$C_2/\#2$	
	8.0	7.5 6.5 } 7.0 6.0	3.0 3.0 } 3.0 2.5			
N2 Mt at 21.0 from #3	2:25	14.0	11.5	6.0	.61	.50 from #2
#3 Mtab 333 cm from #6	2:32	17.5	23.0	14.5	.305	.21 " "
Dr. Callihan	2:42	19.4	44.0	32.0	.159	.094 stop from #2
	2:50	20.55	106.0	79.0	.066	.038 Fill from #3
	2:59	20.5+	Rod at 20cm sup- 2 supercritical - top tamper not reset			
	3:05	21.35	supercritical Rod at 22 cm.			
	3:10	21.15	Shut - critical			tamper reset

Conclusion; Critical at 21.25 ± .1 cm
1.22
.93

H_c 23.40
V_c ~~11.8~~ liters 11.85
M_c ~~1.243~~ Kg 1.24 kg.
H/X 240

Drawback: to 19.4 mto #3
to 5.5 " 2
6.5 + D.V. mto to #1

Expt. 301

10/21/49

Benz
Cronin
Fox
Martin

H/X = 242 10" Al Reactor 1/4" SS tank No other reflector

Instrument #	Trips @	Set @	Source @ 27.5
3	70 x 100	100	in core
4	5 x 200	10	
5	—	1	
6	7 x 1000	25	
7 (P.M)	(3")	—	

Time	Sol.	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
8:35	21.7	9.5, 9.5	21.5, 22.0	1.0	1.0	{#1 MT @ 5.6 #2 MT @ 20.6 #3 MT @ 30.0
9:07	30.0	31.5	77	.30	.29	
9:16	33.1	47	119	.20	.18	from #4
9:31	37.0	80.5	211	.118	.104	
9:45	41.05	190	503	.050	.044	stopped filling #4
9:55	43.1	305, 306	805	.031	.027	from #5.
10:12	45.0	1159	1144	.008	?	
10:24	45.8	Critical with rod @ 35.				
10:32	45.6	" " " @ 39				
10:38	45.4	" " " @ 42				
10:39	45.2	Subcritical Rod Out.				

Tamper @ 70.3 during this experiment.

10:50	46.2	141	349	.063	.067	WITH ROD IN.

Rod with 5 cm of sol.

Tamper lowered to 55.2 cm

	127.5	312	
Tamper Raised to 70.3	128.5	321	
	130.0	317	

45.3
1.07
.93 ✓

H_c 47.30 cm
V_c ~~23.9~~ 24.0 liters
~~Kg = 2.52~~
M_c = 2.58 kg
H/X 240

Tamper Re-lowered to 50.2 cm Ht.

	132.0	316.0

Tamper lowered to 48.2 cm

	137.0	329.0

Super-critical with rod at 34.0 (11.2 cm in soln)
Tamper raised to 49.2 cm. — Subcritical
Super-critical with ~~rod~~ at 36.2 cm. (9.0 cm. in sol.)
Tamper — 51.2 cm. ~~Super~~ critical with rod at 37.5 cm. (7.7 cm in sol.)
" — 53.2 " — " " " " 39.2 " (6.0 " " ")
" — 55.2 " — " " " " 41.0 " (5.2 " " ")
" — 60.2 " Sub-critical with rod out

No other reflector

Some @ 27.5 in scale.

Drainbore. Heights in terms of 10" cylinder.

#1	#2	#3	#4	#5	#6	#7	#8	#9
"MT"	14.0 cm.	10 cm	13.0	13.6 cm	13.0 cm	13.1	6.0	

Leaks air past valve

Seat when closed

NO. 341-M DIETZGEN GRAPH PAPER
MILLIMETER
EUGENE DIETZGEN CO.
MADE IN U. S. A.

Ppmt. 9 Shall be available

Control Rod vs Tamper Height above solution

10" Al Reactor $\frac{H}{X} = 2.42$

Critical at 45.2 cm (Control Rod Out)

¼" Stainless Steel (No other reflector)

Experiment 301

cm Control Rod in sol'n

12.0
10.0
8.0
6.0
4.0
2.0

H_c
V_c
M_c

0 5 10 15 20 25

cm Height of Tamper above solution

Note: Lowering Tamper from 25.1 cm to 15 cm added less activity than addition of 1 millimeter of solution

10/27/49

Cronin
Fox
Moffitt

Exp 302

H/X = 242 10" Al Reactor. Surrounded by 4 - 1"OD Al Shells filled with H_2O. No other reflector. Source @ 17 on scale.

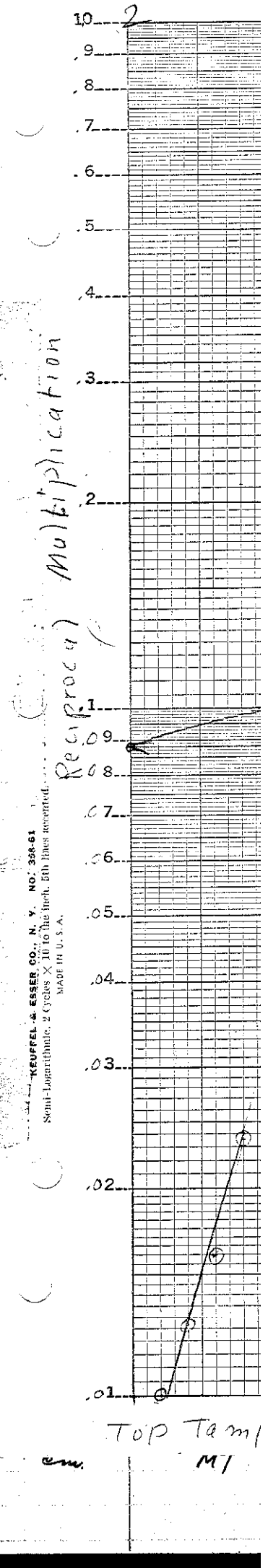
Instrument	Trips @	Set @
3	95 x100	x100
4	5.2 x200	x10
5	——	x2
6	6.5 x1000	x25
7	3" from unit	——

Time	Sub Crit.	C_1	C_2	1/M.	1/M	Remarks.
9:15	10.2	12.0	9.0	1.0	1.0	#8 MT. from #7
		12.0	9.0			
10:22	15.0	22.5	14.5	.535	.62	
10:30	19.05	41.5	31.0	.29	.29	#7 MT @ 19.1
10:41	21.5	76.	62.0	.158	.145	From #6.
		53.	SAFETY IN	.170		
11:08	22.9	139.0	121.0	.087	.079	
	↳ CONTROLS SAFETY IN 58.		47.0	.20	.19	
	CONTROL ONLY 91.		73.0	.13	.12	
11:18	24.1	454	413	.026	.022	
11:28	24.7	Critical with rod 20.5 cm.				
11:32	24.5	Subcritical with rod all out.				

Conclusion: Critical with sight glass @ 24.6 cm ± 0.1 cm

Drawback as per inventory #301

24.6
1.07
.93
He 26.60 cm
Ve ~~13.47 L~~. 13.47 L. ✓
Mc = ~~1.512~~ 1.41 Kg.
H/X 240



10/27/49

- 1"OD Al

ce @ 17 on scale.

/M Remarks.
1.0 #8 MT. from #7
.62
.29 #7 MT @ 19.5
145 From #6.
.074
.18
.12
.022

± 0.1 cm

n L. ✓
Bg.

Reciprocal Multiplication

Reciprocal Multiplication
vs
Separation of Top Tampers
System Critical with tamper in contact.
Ex #303
20" Pu Rods, 1/4" x 24"
Water Reflector

Top Tamper separation, cm

KEUFFEL & ESSER CO., N. Y. NO. 358-61
Semi-Logarithmic, 2 Cycles × 10 to the Inch, 5th lines accented.
MADE IN U.S.A.

cm. M/ 14.0 10.0 13.6 13.6 14.0 13.1 60+DV. M.T.

M/K = 240

8 cycles

Bg

10.48

10/28/49

Experiment 303.

10" Al Reactor, H/X = 242, Fully Tamped. (Four Al shells around reactor - submerged in tamper).

Henry
Gast
Cronin
Fox
Moffitt
Callihan

Purpose: To investigate the sensitivity of a near critical system to top tamper position.

Trip points: #3 - 95 x100; #4 - 5 x20, #6 - 6.5 x10, #7 ok.
Instrument scales #3 x100 #4 x20 #5 x2 #6 x25
Source 6cm above reactor bottom = 13.5 cm on scale -

Time	Soln Hgt. +	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
2:07	9.2	3.25 3.70 (3.50)	2.25 2.15 (2.20)	1.00	1.00	#8 MT from #7
2:17	14.05	7.5	6.0	.147	.37	
2:25	17.0	20.0	20.5	.175	.105	Stopped #7
2:46	18.4	273	286	.013		#6.
	18.7	Super Critical				
	18.5+	Critical with rod in Top Tamper				
3:02	18.4+*	182 (.0096)	194 (.00574)	Top Tamper 1cm above		ONE MINUTE COUNTS
	* Official Critical			↳ .0096	.00574	
3:03		139 (.0125)	145 (.0076)	Top Tamper 2 cm above		
		109 (.016)	112 (.0098)	Top Tamper 3 cm above		
		77.5 (.0234)	78.5 (.014)	4 cm above		
		57. (.0307)	60 (.0184)	5 cm "		
		47. (.037)	50 (.022)	6 "		
		41. (.043)	43 (.026)	7 "		
		36.0 (.049)	37. (.030)	9 "		
		26.5 (.066)	26. (.042)	14 "		
		20. (.088)	21. (.052)	20 "		
		16 (.109)	16 (.068)	30 "		
		5½ (.320	5.0 (.22)	∞		

Reciprocal Multiplications are in parenthesis

Conclusion: Critical @ 18.4+ cm on right glass.

Inventory in terms of 10" reactor.

Gl #	1	2	3	4	5	6	7	8
cm.								
MT	14.0	10.0	13.0	13.6	14.0	13.1	6.0 + D.V.	

18.4
1.27
19.3
H_C = 20.55 cm
~~V_C = 10.3 → 10.48~~
Me = ~~1.162~~
g = 1.09 Eg
M.T. ——
M/X = 240

10/31/49

CRONIN — Took inventory of unused U - Samples to Lab -

HENRY
MACKLIN
FOX — Kenyon + Henkin, AEC, Inspectors here in afternoon to observe inventory procedures.

MACKLIN
FOX — 11/1/49 Checked manifold for leaks.

2:15P Filling
:20 H = 5.8
:25 = 9.2
:40 = 16.8
:45 = 19.5
:50 = 22.
:59 = 24.(
3:07 = 24.'
= 25.

10

TRIP
INSTRUME
Sam

DRAIN

11/1/49

MACKLIN
FOX
CALLIHAN.

EXPERIMENT 304

10" Al REACTOR, H/X = 242/243; SURROUNDED BY THREE WATER FILLED SHELLS. NO TOP OR BOTTOM TAMPER.

TRIP POINTS: #3 @ 92 HRD, #4: 4.5 @ 250; #6: 6.8 @ 1000, # 7 @ X -
INSTRUMENT SCALES: 3 X 10, 4 X 20, 5 X 1, 6 X 25
Source - 8 cm from bottom of reactor; at 15.5 cm on scale.

2:15P	filling from #8 (H).					
:20	H = 5.8 cm	#8 empty		filling from #7		
:25	= 9.2 "	I 13.0	II 10.0			
		13.5	9.5			
		13.3	9.8	I	M-1 II	
:40	= 16.8	33.5	25.0	0.40	0.39	#7 G Empty filling from #6 F
:45	= 19.5	56.0	42.5	0.24	0.23	
:50	= 22.1	104.5	93.0	0.13	0.11	
:59	= 24.0	336.0	309.5	0.04	0.03	
3:07	= 24.7+	NOT QUITE CRITICAL.				
	= 25.0	CRITICAL WITH ROD 5 cm in solution -				

CRITICAL WITH SIGHT GLASS = 24.9 cm.

DRAIN BACK TO 16.8 into 6F.

24.9 Cm
1.07
.93
Hc 26.90 Cm
Vc = 13.62 L ✓
Mc = ~~4.530~~ 1.42 Kg.
H/X = 240

Calliham
Cronin
Fox
Moffitt

EXPERIMENT # 305

239

11/1/49 — 10" Al REACTOR, H/X = ~~24~~; SURROUNDED BY two Al SHELLS WATER FILLED. NO OTHER TAMPER.

→ See Note on exp 306
Repeated in exp # 308

11/2/49 — 10"

MACKLIN
FOX
CALLIHAN.

SCALES, TRIP PTS, ETC SAME AS 30 #.
USING SAME BACK GROUND COUNT.

Scales
Trips:

	#	H	I	II	M⁻¹ I	M⁻¹ II	Time	#
3 36	#	= 16.8 cm	36.0	37.0	0.37	0.27	9:44	1
			36.5	35.0			filling for 6F	
56		= 22.0	103	106.5	0.10	0.09	9:56	2
4:00		= 24.0	245	261	0.05	0.04	10:16	2
07		= 24.95	NOT CRITICAL ROD OUT.				10:25	2
10		= 25.3	" " " "					1
13		= 25.7	CRITICAL WITH 6 cm ROD IN SOLUTION.					
							10:33	2
			CRITICAL WITH SIGHT GLASS 25.5 cm -				10:34	2
								Conclusion

DRAINBACK - TO INVENTORY SHOWN Pg. 131. EXCEPT : # 7 HAS 11.0 cm
" 8 " 5.7 + DV.

25.5
1.07
1.93
Hc = 27.50
Vc = 13.92
Mc = 1.568 Kg

} NG

NB → Ht. to
shells co
canter c
to inval
#304 & 6
#308 & 2
This gro
cylindrica
to exp
from u

Callihan
Cronin
Fox
Morpith

11/2/49

Experiment 306

10" Al Reactor H/X = ~~242~~ 239 Surrounded by one water filled Al shell

No other reflector. → See note at bottom of page
Repeated as exp 307.

Scales #3 x100 #4 out #5 x1 #6 x25 ⋕ Source 10 cm off S.Town.

Trips: #3 92x100 #6 6.8x1000 #4 out

Time	H₂O	#1	#2	1/M₁	1/M₂	Remarks
9:44	13.3	8.0, 8.0 (8.0)	9.5, 9.0 (9.25)	1.0	1.0	#8 MT from #7
						#7 MT @ 16.8
9:56	20.1	19.5	25.5	.41	.362	from #6
10:16	24.1	36.5	52	.22	.18	
10:25	28.1	19.6	309	.04	.03	STOPPED from #6
	28.1+	~ 80	~ 112	ROD IN.		from #3

Rod worth about 13 cm of soln.

10:33 29.2 Critical with rod @ 26 cm.

10:34 29.05 Subcritical with rod out.

Conclusion Critical @ 29.15 cm. on scale.

H_c 29.15
1.07
.93
H_c = 31.15
V_c = 15.76 liters
M_c = 1.769 kg
} KLG

NB → At the end of this experiment it was found that one of the shells comprising the 3rd annular ring of water from the center contained sufficient water (~45 cm above bottom of reactor*) to invalidate the results of experiments 305 & 306. Experiments #304 & below would not be affected. #305 & #306 were repeated as #308 & #307.

This group suggests that it is in general better to fill successive cylindrical shells than to empty them the latter operation not being subject to easy verification. (JWC)

* from wgt. measurements.

SHELLS

EE TAMPER.

Note on exp 306
ed in exp #308

ing from 6F

LUTION.

VAS 11.0 cm

J.7 + DV.

Cronin
Fox
Morfitt

11/2/49

Exp 307 Repeat of 306.

10" Al reactor H/X = 239/240 Surrounded by one Water-Filled Shell. No other reflector. Scales Trip Point same as 305

Cronin
Fox
Morfitt

10"

Time	Height	C_1	C_2	$1/M_1$	$1/M_2$	Remarks		H
		6.5, 6.25	10.				1:26	16.8
11:30	12.0	Av. (6.13)	(10.0)	1.0	1.0	#8 MT. Using #7		
11:37	24.1	34.5	51.	.18	.196	#7 MT @ 16.8. Using #6		
11:47	28.2	83.	131	.074	.076	stepped #6	1:34	24.0
11:53	29.15	121	186	.051	.054	from #3	1:42	25.4
12:03	31.6	Subcritical with rod out. Close					1:50	26.5
12:07	31.7	Critical with rod @ 26cm above bottom.					1:58	26.4

Conclusion Critical @ 31.65 cm. on scale

Sight gloss	31.65 cm.	of #306
Zero Correction	1.07	
Bottom Correction	.93	

H_c = 33.65 cm corrected height

V = 17.05 ℓ V

M_c ~~1.919~~ Kg X

= 1.78 Kg X

H/X 240

11/2/49

Experiment #308 Repeat of #305

Cronin
Fay
Morfitt

10" Al. reactor H/X = 2.42 Surrounded by two water filled SS tanks
No other reflector. Sources & Instruments as in #305
Using Background of #306

H	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
16.8	13.5	17.0			
	14.0	16.0			
	(13.75)	(16.5)	.443	.606	#7 & #8 MT. from #6.
24.0	64	87	.096	.115	Stopped #6
25.4	153	214	.04	.047	Est. Crit 26.4
26.5	Critical with rod @ 25 cm above bottom.				
26.4	Subcritical with rod out.				

Conclusion: Critical with solution height on sight glass @ 26.45

Sight Glass H_c = 26.45 cm. cf. #305
Zero correction 1.07
Bottom Correction .93
H_c = 28.45 cm. ✓ corrected height.
CRIT VOL = 14.41 L. ✓
CRIT MASS = ~~145~~ kg.
~~150~~ 151 kg
H/X 240

water-filled
305.

1/M Remarks
0 #8 MT. Using #7
96 #7 MT @ 16.8. Using #6
76 Stopped #6
-4 from #3
Bottom.
1:26
1:34
1:42
1:50
1:58
rod

138 11/2/49

Exp #309 H/X ≈ 242

Cronin
Fitz
~~Collin~~
Morfitt

10" Al reactor surrounded by 4 shells 1" OD containing dry $Bi_2O_2CO_3$ at .529 Bi/cc (p97) No other reflector.

Time	Sch. Ht.	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
2:20	12.5	5.5 6.0 (5.75)	11.5 11.0 (11.25)	1.0	1.0	#8 MT.
2:31	20.0	13.0	23.5	.44	.48	#7 MT from #6
2:37	25.0	20.0	36.0	.288	.278	#6 MT @ 29.5
2:45	33.3	39.5	72.0	.145	.139	
2:53	40.1	90.0	158.	.063	.063	#5 MT @ 41.5
3:02	~~#5~~ 44.9 44.9+	290. Rod in.	518	.0198	.0193	from #4
3:04		≈ 81	≈ 140	.071	.081	Est. crit 47.9

Rod worth between 7 & 8 cm. centimeters

3:12 48.15 Critical with rod @ 35 cm from bottom
3:14 48.05 " " " @ 37 " "
3:22 47.0, 46.9 " " " @ 43.5 " "
3:25 46.7 Subcritical with rod out.

Conclusion Critical @ 46.8 cm on sight glass.

3:50 Drain back-
#5 - 12.5 cm
#6 - 12.7
#7 - 11.0 cm
#8 - Dr + 5.8 cm

Sight glass at Critical = 46.8 cm
Bottom Correct 0.93
~~Zero~~ 1.07
CRITICAL HT. 48.8 cm
Vol. 24.72 ℓ
Mass. ~~24.8 Kg~~ 2.58 Kg
H/X 240

11/3/49

Cronin
Fitz
Morfitt

10"
dry

Time	
9:47	
9:57	
10:04	
10:14	
10:25	
10:37	√1.6
10:38	√1.5

11/3/49

Experiment #310 H/X = 242

containing
Nectar.

Crown
Fry
Martin

10" Aluminum reactor surrounded by 2 shells 1" OD containing dry $Bi_2O_2CO_3$ @ 0.52 g Bi/cc 92% No other reflector.

12	Remarks	Time	Soln Hgt.	C_1	C_2	1/M.	1/M2	Remarks
	#8 MT.	9:47	13.2	6.75	6.75	1.0	1.0	#8 MT
		9:57	25.2	16.5	21.0	.41	.32	#7 MT
P	#7 MT from #6	10:04	35.3	33.5	50.	.201	.135	#6 MT
78	#6 MT @ 29.5	10:14	45.1	87	146	.078	.046	#5 MT @ 41.8
39		10:25	50.1	363	651	.018	.010	Est crit. 51.5
163	#5 MT @ 41.5	10:37	51.6 ~~51.65.16~~					Critical with rod out. Extremely long period
0193	from #4	10:38	51.5 ~~5.15~~					Subcritical " " "
081	Est. crit 47.9							

bottom
"
"

Conclusion critical @ 51.6 cm.

Drain back-

#4 ~~to~~ 41.8
#5 - 12.5 cm
#6 - 12.7 cm
#7 - 12.0
#8 - DV + 4.8 cm

CRITICAL at Sight Glass = 51.6

Bottom Correction	0.93
Zero "	1.07
CRIT HT	53.6 cm
CRIT VOL	~~27.2 kg~~ L 27.15
" MASS	~~2.93 kg~~ 2.84 kg

H/X 240

11/4/49

Experiment # 311

11/4/49

Fox — 10" Al Reactor H/X 242 — 4 shells of $(UO_2)(NO_3)_2$ approx 24.6% U by wgt. NO other reflector

Morfitt — 10

Morfitt
Cronin

Source 8 cm from bottom

Fox
Cronin

Instruments	Trip Pt.	starting Scale
#3	92 x100	x100
#4	—	—
#5	—	x 1
#6	8 x1000	x 25
photo-Multiplier	5mg Ra ½" from tube	—

Pa
Sola

						11:27	16
						11:35	22
						11:45	23
10:10 AM	Red Light On					11:50	24
a	Solution Ht.	C_1	C_2	$\frac{C_0}{C_1}$	$\frac{C_0}{C_2}$	11:58	2
10:14	9.5 cm	3.75	5.25		DV from #8 not from #7	12:02	2
		4.25	6.00				
		3.75	5.50				
		4.00	5.50				
10:27	15.2 cm	8.50	10.75	.47	.51	#7 MT at 16.8	
10:35	18.0 cm	14.00	16.5	.285	.305	from #6	
10:41	20.0	20.5	26.0	.195	.21		
10 51	22.0	39	47	.102	.118		
	control Rod in	28	32	.143	.172 ≅ 1.2cm of solution		
11:02	23.5	102	127	.039	.043		
11:08	24.6	Rod 19cm from bottom		critical			
11:11	24.45	Rod 23 cm from bottom		critical			
11:12	24.40	Rod out		sub-critical			

Critical at 24.42 ± .05 cm
Bottom corr 0.93
Zero 1.07
CRIT HT ~~24.4 cm~~ 26.4 cm
~ Vol ~~14.4 L~~ ~~13.4 L~~ 13.37 ✓
~ Mass ~~[illegible] lbs~~ ~~130 kg~~ 1.40 Kg.
H/X 240

11/4/49

Ex 312

Morfitt

10" Al Reactor $\frac{H}{x}$ 242 3 shells $UO_2(NO_3)_2$ no other reflector

For Cronin

Source 8 cm from bottom

Instruments	Trip	start
#3	92 x100	x100
#5	—	x1
#6	8 x1000	x25
Photo Multiplier	1/8" from tube	—

Solution	#1	#2	c_0/c_1	c_0/c_2	
11:27	16.8	12.5	14.00	.32	.39	c_0 = same as Ex 311
11:35	22.1	37.	47	.108	.117	from cyl 6 ½"
11:45	23.5	71	89	.056	.062	
11:50	24.5	152	201	.026	.027	
11:58	25.4	Rod 19cm from bottom		critical		
12:02	25.2	Rod out		sub critical		

Critical at 25.3 ± 0.1 cm

Bottom Cor. 0.93

Ref " 1.07

Crit. Ht. 27.30 cm ✓

" Vol 13.83 ℓ

" Mass ~~1.39 kg~~ 1.44 kg 1.45 kg

H/X 240

24.6% U by wgt.

DV from #8 not from #7

#7 MT at 16.8

05 from #6

21

118

172 ≅ 1.2 cm of solution

.043

al

ial

- critical

142

11-4-49 Exp. 813

Henry
Fox
Morfitt
Cronin

10" Al $\frac{H}{X}$ 242 2 shells $UO_2(NO_3)_2$ no other reflector

Source at.

Instrument	Trip Points	Start
#3	92 X100	X100
#5	—	X1
#6	8 X1000	X25
Photo Multiplier	1/8" from tube	—

1:20 PM	Red light on					
	Solution	#1	#2	$\frac{Co=4.00}{C_1}$	$\frac{Co=5.50}{C_2}$	
1:22 PM	16.6	11.5	16	.348	.342	From #6
1:25 PM	22.0	31.0	42.5	.129	.129	
1:31 "	23.9	52.5	71.0	.076	.078	stop #6
1:39 "	~~26.0~~	166.5	233.5	.023	.023	From #3
1:45	27.2+ Rod in	120.0	157.0	.035	.033	
1:50 "	27.1 Critical with rod at 22.0 [5.1 cm. in solution]					
1:52	27.0 " " " " 24.0 [3.0 " " "]					
1:53 "	26.9 Sub-critical with rod out					

Conclusion: Critical at 26.95 cm.

Bottom correction	1.07
Zero Correction	0.93
CRITICAL HEIGHT	28.95 cm
Volume	14.7 ℓ 14,706 ✓
Mass.	~~1.54~~ ~~1.48~~ Kg 1.53 Kg

H/X 240

11/4/49

Fox
Cronin
Morfitt
Henry

10" Al

	Sol.
2:00	16
2:07	2:
2:13	26
2:17	2
2:30	31
	→
2:38	32
2:47	3:
2:49	3:
2:52	3:

D

11/4/49 Exp. #314

Roy
Cronin
Moffitt
Henry

10" Al cylinder. #1 shell $UO_2(NO_3)_2$ — no other reflector

other constants same as Exp. 313. H/X = 24 ✓

Sol. Ht.	#1	#2	C_0/C_1 : 4.60	C_0/C_2 : 5.52	
2:00	16.9	12.5	16.75	.32	.33 From #6
2:07	22.0	20.5	30.0	.19	.18
2:13	26.0	36	54.0	.11	.10
2:17	28.0	52.0	80.0	.077	.065 #6 empty at 29.5
2:30	31.0	148.0	219.0	.027	.026 fill from #3
→ Rod in	60.0	90.0		.060	.061
2:38	32.1	350.0	542.0	.011	.010
2:47	33.2	Critical with rod at 25.0 [8.2 cm in sol.]			
2:49	330	" " " " " 29.0 [4.0 " " "]			
2:52	327	Sub-critical " " out			

Conclusion: Critical at 32.85 cm.

1.07
.93

Hc = 34.85
Vc = 17.65 L ✓
Mc = ~~1.78~~ 1.84 Kg.
H/X 240

Drainback
#6 – 13.0 cm
#7 – 13.0
#8 –

Location of Catastrophe Film

Badge #	Location
1.	Personnel (located at Film Badge rack)
2.	Control Room South Wall
3	" " North Wall
4.	Reactor Room Reactor
5.	" " West Wall
6.	" " East Wall
7.	Office (Rm. 3A) West Wall
8.	Rear Door of Bldg. @ gate in fence.
9.	Post #9
10.	Room 10 West Wall
11.	Vestibule
12.	North East Guard Tower.

First Batch of film installed 7/29/49

Check List

	238	239	241	242	243	244	245	246	247	248	249	251	253	255	256	258	259	261	262	263	264	265	266	267
Instruments																								
1. Issue dosimeters & film badges	DFC	FC	JF	DC	DC	JF	DC	DC	JF	JM	✓	45 DC	JF	JM	JM	D C	JF	DC	JF JM	JM	DC	JM	JM	JM
2. Check Instruments with source	DFC	FC	DFC	FC	✓	DC	FC	FC	FC	✓		JF	FC	FC	JF	FC	JF	FC ✓	FC	JF	JF	DC	FC JM	JM JF
3. Record Trip Points	JWM	D C	JF	JM	–	DC	DC	FC	JM	✓		JM	FC	FC	JM	FC	DC	DC ✓	DC	DC	DC	RH	JM	DFC
4. Put exp numbers on charts	JWM	JF	FC	JM	DC	DC	DC	DC	FC	✓		FC	FC	FC	JM	JF	JF	FC ✓	DC	DC	HH	DC	JM JF	JM
5. Put sources in operating position	JWM	FC	JM	FC	DC	DC	FC	FC	JF	✓		JM	FC	✓F	JM	FC	DC	JF ✓	JF	JF	JF	DC	JF	JM
6. Check on location of ALL sources	DFC	FC	FC	FC	DC	JF	JF	FC	JM	✓		JF	JF	FC	JF	JM	DC	FC ✓	FC	JM	JF	DC	FC	JF
7. Bring survey meter to control room	JWM	FC	JM	DC	JW	DC	DC	DC	JM	✓		JM	DC	JF	JM	JM	DC	FC ✓	DC	JM	JF	DC	JF	JF
Solution System																								
8. Solution Inventory in terms of reactor lit.	JWM	DC	JM	JM	Jm	DC	DC	DC	JM	[redacted]	JM	✓	✓	✓	✓	✓	FC ✓	DC	–	✓	✓	✓	✓	
9. Check all valves anywhere in system. inc Dump Valve	JKF JWM	JF	JF	JM	JF	JF	JF	JF	JF	[redacted]	JF	JF	JF	JM	JF	JF	JF ✓	JF	JF	JM	DC	VM		JM
10. Check Pins in Cyl. Valves. Light on feed line	JKF	DC	JF	JM	JF	JF	JF	JF	JF	[redacted]	JF	JF	JF	JF	VF	DC	TF ✓	DC	JF	JF	✓	FC JM	JF JM	JM
11. Check Air Pressure	JWM	FC	DFC	JM	JF	DC	JF	JF	JF	✓		JF	JF	JF	JM	JF	DC	DC ✓	DC	JM	JF	✓	JM	JF JM
Reactor System																								
12. Water in Temper Tank & Top Temper where reg.	DFC	FC	–	JF	JM.	JF DC	–	–	DC	✓		JF	JF	FC	JF	JF	JF	FC ✓	DC	JF	JF	HN	JF	JF JF
13. Smooth Action Temper, Limit Switches	JWM	FC	–	JM	JM	JF	–	–	JF	✓		JF	JF	–	JM	JF	JF	JF ✓	DC	JF JM	✓	✓	DC	JM JM
14. Set safety rod, Zero control rod.	JKF	FC	JM	JM	JF	JF	JF	DFC	DF	✓		JM	JF	VF	JM	FC	DC	JF ✓	JF	JM	✓	✓	DC	JM FC
15. Check All pulleys	JWM	JF	FC	JM	JM.	JF	FC	FC	JF			JM	JF	JF	JM	JF	DC	DC ✓	DC	JF	✓	✓	JF	✓ ✓
16. Tape on Dump Pan	DFC	JF	JF	JF	✓	✓	–	–	JF	✓		JM	–	JF	JF	JF	DC	HH ✓	✓	✓	–	✓	✓	✓ ✓
17. Set Dump Spacing	DFC	FC	FC	JM	JF	JF	JF	JF	JF	✓		JF	JF	FC	JM	JF	DC	JF ✓	FC	DC	JM	✓	JF	✓ FC
Final Check																								
17. Get Key to Rea Gate	DFC	FC	JM	DC	DC	DC	JM	✓		cbs	DC	FC	JM	FC	DC	FC ✓	DC	JM JF	✓	JF	✓	FC		
18. Notify Guards, Check Personnel, Red light.	DFC	FC	DFC	FC	DC	DC	DC	DC ✓	JM	✓	cbs	DC	FC	JM	JM	JF	DC ✓	DC DC	✓	JM	FC			
19. Record Instrument Scales		DC	JM	DC	DC	DC	DC	FC	JM	✓	cbs	DC	FC	JM		DC	DC	DC DC	DC	V	JM	✓	FC	

X 251 253 254 255 256 258 259 260 262 263 264 265 266 267 270 272 273 278 280 284 288 289 Dilution Dilution 292 293 294 295 296 297 298 300 301 302 303 304 306 310 311 315 316

✓ LS DC JF JM JM DC JF DC JM JM DC JM JM JM JF JF FK JF JF JM JF FC ✓ ✓ ✓ JM RM RM ✓ FC ✓ JF FC DC RM JF FC FC FC FCY
✓ JF FC FC JF FC JF FC JF JF DC FC JM JM JF JM JF DFC JM DFC JF FC JF JM JF JF FC FC FC JM ✓ ✓ ✓ JF FC CB ✓ JM DC ✓ FC JM FC JF JF JF DFC JM FC JM FC JM FC FC
✓ JM FC FC JM FC DC DC DC DC RH JM DFC FC DFC DFC JM JM JF JM FC JM ✓ ✓ ✓ JM FC FC ✓ JM ✓ JM JM DC DC FC JM JM JF JF
✓ FC FC FC JM JF JF FC DC HH DC JM JF JM FC DFC DFC FC JM JF JM FC JM — — ✓ JM FC FC ✓ FC ✓ JM JF FC DC JM — JM FC HH
✓ JM FC JF JM FC DC JF JF JF DC JF JM JM DFC JWM JWM JWM ✓ JM FC FC ✓ ✓ ✓ JM FC FC ✓ FC ✓ DF JF FC JF JM JM JM FC FC
✓ JF JF FC JF JM DC FC JM JF DC FC JF JF JM DFC DF JF JF JF FC FC ✓ ✓ ✓ JM FC FC ✓ JM ✓ FC JF JF JF JM DF FC FC ✓
✓ JM DC JF JM JM DC FC DC JM JF DC JF JF JF JM FK ✓ JM ✓ FC JF ✓ ✓ ✓ ✓ ✓ FC FC ✓ ✓ ✓ ✓ JM ✓ DC JM JM ✓ ✓ ✓

[redacted] JM ✓ ✓ ✓ ✓ ✓ FC ✓ DC ✓ ✓ ✓ ✓ ✓ ✓ JM ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ JF ✓ ✓ ✓ ✓ ✓ JM ✓ ✓ ✓ ✓
[redacted] JF JF JF JM JF JF JF JF JF JM DC JM JM ✓ JF ✓ JF ✓ FC JF JM ✓ ✓ ✓ JF JF ✓ ✓ JF ✓ JF JF JF JF JF JF JM JF ✓
[redacted] JF JF JF JF JF DC JF DC JF JF ✓ FC JM JF JM JM JF JM JF ✓ JF ✓ FC JM JF JM JF ✓ ✓ ✓ JF JF ✓ ✓ JM ✓ FC JM JM JM RM JM JF JF FSF JM JF ✓
✓ JF JF JF JM JF DC DC DC JM JF ✓ JM JF JM DFC DH ✓ JF JM ✓ FC FC JM ✓ ✓ ✓ JM FC JF ✓ JM ✓ JM JM JF RM FC JM JM FC ✓

✓ JF JF FC JF JF JF FC DC JF JF HN JF JF JF FK — JF — no — FC JF — — — JM FC RM — JF ✓ — — JF ✓ JF — — — —
✓ JF JF — JM JF JF JF DC JF JM ✓ ✓ DC JM JM DFC — JF FC — no — FC JM — — — JM FC ✓ — JM ✓ — — ✓ ✓ — — — — —
✓ JM JF JF JM FC DC JF JF JM ✓ ✓ DC JM FC DFC DFC JF FC ✓ FC RM JM ✓ ✓ ✓ JM FC ✓ ✓ JM ✓ JM DC JF JF JM JM JF FC —
✓ JM JF JF JM JF DC DC DC JF ✓ ✓ JF ✓ ✓ JF JF JF JF ✓ FC JF JM ✓ ✓ JF JF ✓ ✓ JF ✓ JF JF FC JF JF JF ✓ —
✓ JM — JF JF JF DC HH ✓ — 230
✓ JF JF FC JM JF DC JF DC JM ✓ JF ✓ FC DFC — — FC — FC JF JF — — ✓ JM FC FC ✓ JF ✓ JM FC RM FC FC ✓ JF JF

✓ C85 DC FC JM FC DC FC DC JM JF ✓ JF ✓ FC DFC DFC FC FC ✓ FC RM FC — — ✓ JM FC ✓ ✓ D.C. ✓ JF JF JF DC DC ✓ FC FC ✓
✓ C85 DC FC JM JM JF DC DC ✓ JM FC DFC DFC FC FC ✓ FC DC JF ✓ ✓ ✓ JM DC DC JM ✓ JF DC DC JF ✓ JF DC ✓
✓ C85 DC FC JM DC DC DC DC ✓ JM ✓ FC FC JM JM ✓ JF ✓ JM DC JM ✓ ✓ ✓ ✓ FC ✓ ✓ FC ✓ JM DC DC JM ✓ JM DC ✓

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17.00.
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