BOOK56R

Notes:

Blank pages: inside page opposite page 1, 3, 4, 21, 126, 152, 153, inside back page opposite page 156

-page 9 has (8.5x11) graph sheet attached
-page 94 has 2 (8.5x11) sheets attached
-page 108 has (8.5x11) sheet attached
-page 122 has 2 big graph sheets (print is light) attached
-page 153/154 has piece of red tape at top

Scanned by:
Sheila Finch
RSICC /Oak Ridge National Lab.
August 17, 1999

DRAWER 4
BALK OF
DRAWER
ALL CYLINDERS

SECRET

COMPUTATION BOOK

NAME	Number
K-1095 NITRATE EXPERIMENTS —	30

Course .....

Used from 11/7 1949, to ..... 19.....

EXPERIMENTS 315 →

HARVARD COOPERATIVE SOCIETY
Cambridge, Massachusetts

RESTRICTED DATA

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

SECRET

Inv. 60

cylinder areas

Diam.	cm^2 area
9	410.3
10	504.6
12	729.5
15	1140.0

INV. 12

BE AUT 58

Inv. 58

SECRET

Correct documentation
5-25-60

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EXPERIMENT 315

11/7/49

FOX
CRONIN
CALLIHAN

10" AL REACTOR, H/X = 2.42, ONE SHELL FILLED WITH H_3PO_4. - NO OTHER TAMPER-

TRIP POINTS, #3 - 92±100, #6 - 6.5 x1000, #7 - OK-
INSTRUMENT SCALES, #3 X100, #4 X6 #5 x5, #6 X 25.

SOURCE - 8cm above bottom of reactor - = 15 cm on scale.

		I	II	I	II	
10:30A	Filling D.V from 8H.					
35	#8 Empty at 5.1 cm - filling from #7					
40	H = 9.2 cm	6.25	7.25			
		5.75	7.25			
		6.0	7.25			
48	=19.5	21.5	24.5	0.28	0.30	#7 Empty, filling from 6F.
56	=22.5	31.0	35.5	0.19	0.20	
11:05	=24.1	36.0	43.0	0.17	0.17	
		38.0	45.0			{Checked for HO_3 & POC leaks - blew bowl out light glow - Response to control rod & source OK
:20	= 25.0	41.0	48.0	0.15	0.15	
:27	=28.0	72.5	83.0	0.08	0.09	
:32	=30.5	158.0	184.0	0.04	0.04	stop filling from #6; fillings from #5E
45	=32.2	636	742	0.01	0.01	
	✓	125	137	0.05	0.05	CONTROL ROD IN. (VALUE: 2 cm).
:54	32.6	CRITICAL - ROD OUT.				
	32.5	SUB CRITICAL				

CRITICAL. SIGHT GLASS AT 32.6 cm.
Bottom correction 0.9
Zero - 1.1
Critical Ht 34.6 cm
- Vol 17.5ℓ ✓
- Mass 1.83 ~~+.7~~ kg.
H/X 2.40

INVENTORY: #5 - 12.5 cm.
#6 - 12.5 cm.
#7 - 9 cm.

6

11/7/49

Exp. 316 $\frac{H}{X} = 242$

10" Al Reactor 2 shells H_3PO_4 no other reflector.

Henry
Fox
Cronin

Source at 8cm from bottom
Instruments same as 315

	Sol'n Ht.	#1	#2	c/c	c/c	
3:05 PM	9.3	8.25	4.25			
		8.00	5.00			
3:15	18.7	19.0	13.0	.42	.355	
3:22	21.8	28.5	23.5	.28	.19	stopped from F
3:30	25.0	62.5	60.5	.13	.075	from #3
3:40	27.1	944	975	.0085	.005	
3:50	27.25	Rod out	barely supercritical			
	27.2	Rod out	barely sub critical			

Critical at 27.225 ± .025 cm.

5:00 – Phosphoric acid {boiled over / or / leaked out} and was in tamper tanks – necessary to take shells apart and rinse out tanks and shells.

11-8-49 Shells checked for leaks – none apparent.

Critical – right glass – 27.2
Bottom counter 0.9
Zero – 1.1
CRIT. Ht – 29.2 cm
– vol 14.86R ✓
– mass 1.55 ~~kg~~ Kg
f/x 240

Exp. 317 $\frac{H}{X}$ 242

11/8/49

for Maclain Cronin

10" Al Reactor 4 shells H_3PO_4 no other reflector
Source at 8 cm from bottom

Instruments	Trip Point	Starting Scale
#3	90 ×100	×100
#4	NG	NG
#5	——	×1
#6	7 ×1000	×25
Photo-multiplier	3" Sing Ra	—
Process monitor	1000 c/m	——

Time	Sol'n Ht	#1	#2	c_0/c_1	c_0/c_2	
1:35						#8 empty at 5.0 cm.
1:40	9.3	3.75 } 3.5 3.50 }	5.25 } 5.5 5.70 }			Filling from #7
1:48	16.0	11.0	14.0	.32	.39	#7 empty 18.5 cm
1:56	18.1	19.5	20.0	.24	.275	
2:05	21.0	31.5	40.0	~~.11~~	.137	Filling from #6
2:16	23.0	77.0	96.0	.045	.057	
2:25	24.5	347	430	.001	.0013	Filling from #3
2:35	26.3	Critical rod at 14 cm Super-~~Crit~~ rod at 19.6 20 sec later it became sub-crit. no other change Super crit 26.0 20 sec later it became sub. crit " " " " This is due to a density effect caused by the attack of the H_3PO_4 on the Aluminum increasing rapidly with temp. — a sort of auto-catalytic effect. Final temp were near boiling pt. of water.				

The shells were ~~rinsed~~ outside, dumped in barrel and rinsed.

Drawback to previous value:

Scaled glass at critical	26.3 cm	
Bottom corr.	0.9	
Zero	Tol	
Critical Ht	28.3 cm	✓
Vol	14.3 ℓ	
max. 1.50 kg ~~+1.1~~ Kg.	+.4	
	4/4 240	

#8 – DV + 5 cm. ≈ 10"
#7 – 13.5 " " " Others not used
#6 – 13.0 " " "
#3 – as before – 13.0 approx

8 Cowan
For Morfitt

Trip Points { #3 92x100 #6 6x1000

Exp # 3/8 11/XII 242 Starting Scales { #3 x100 #4 x10 #5 x5 #6 x25

11/18/49

10" Al flat-bottom ("movable" cyl. used in last reaction) reactor provided with an additional control rod operating horizontally along the diameter of the base. The control rod was built to Hanford specifications. Cylinder otherwise normal & completely water tamped.

Purpose of experiment: To check the effectiveness of the control rod in the proposed Hanford design of their critical mass experimental apparatus. See Hanford "feasibility report.

Source @ 7.5 cm from bottom. H. Control Rod completely away from reactor. Reading on H.C.R. scale = 69.0 cm.

When the H.C.R scale reads 0.0 the rod is 15.2 cm past the outer surface of the reactor on the other side of the reactor from which the control rod enters.

11-11-49 — Experiment not run on 11-10 because of lack of time

Time	Hgt. Soln.	#1	#2	C/C1	C/C2	Position of rods	Remarks, background
9:40	9.3 cm	2.5 2.25 } 2.3 2.25	2.5 3.0 } 2.6 2.25			out	
10:00	12.0 cm	3.25 3.00	3.50 3.50	.71	.74	out	
10:14	14.4	4.25 4.25	6.50 6.00	.54	.40 .43		
10:20	14.4	4.00 4.50 4.25	5.75 5.50 5.50	.57 .54 .51 .54	.45 .46 .47 .47	Hanford C Rod in Normal Rod in	other Rod out Hanford Rod out
10:30	16.2	6.00 7.00 6.25 5.25	9.25 9.50 9.50 8.50	.38 .33 .37 .43	.28 .27 .30	Normal Rod in Normal Rod out Normal Rod out	HCR out HCR out HCR IN
10:55	18.3	10.25 11.00 10.0	18.50 20.5 17.5	.225 .208 .23	.14 .13 .16	NORMAL Rod IN NORMAL Rod out Normal Rod out	HCR out HCR out HCR IN
11:07	19.4	17.5	35	.13	.074	Normal Rod in	HCR out
#40		22.25 16.0	42.25 30.5	.10 .144	.061 .085	Both Rods out Normal Rod out	 HCR IN
11:30	20.0	29.0 39.0 24.5	59.0 76.5 45.5	.079 .059 .094	.044 .034 .057	Normal Rod IN Both Rods out Normal Rod out	HCR out HCR IN

NOTE: 11/21/49 CRONKITE says "Normal" Rod was in tamper, in contact with cylinder

Exp 318 (cont)

Time	Sol'n Ht.	#1	#2	c_0/c_1	c_0/c_2	Zero = 10 cm Normal Rod	HCR
11:42	20.6	104.5	214.5	.022	.012	IN	out
		43	86.5	.053	.03	IN	IN
		61	122.5	.038	.02	out	IN
		Critical				at 30 cm	out
12:05	20.5	sub-critical				out	out
		Critical at 20.55 ± .05 cm					
12:15	20.8	54.0	112	.042	.023	IN	IN
		111.0	238	.025	.011	OUT	IN
	21.1	167	~~280~~ 355	.013	.007	IN	IN
		Critical				20.5 (0.6 cm below sol. lvl.)	IN
12:30	21.0	Critical				27.0 (6 cm above sol. lvl.)	IN
		Critical at 20.9 ± 0.1 cm					

20.55

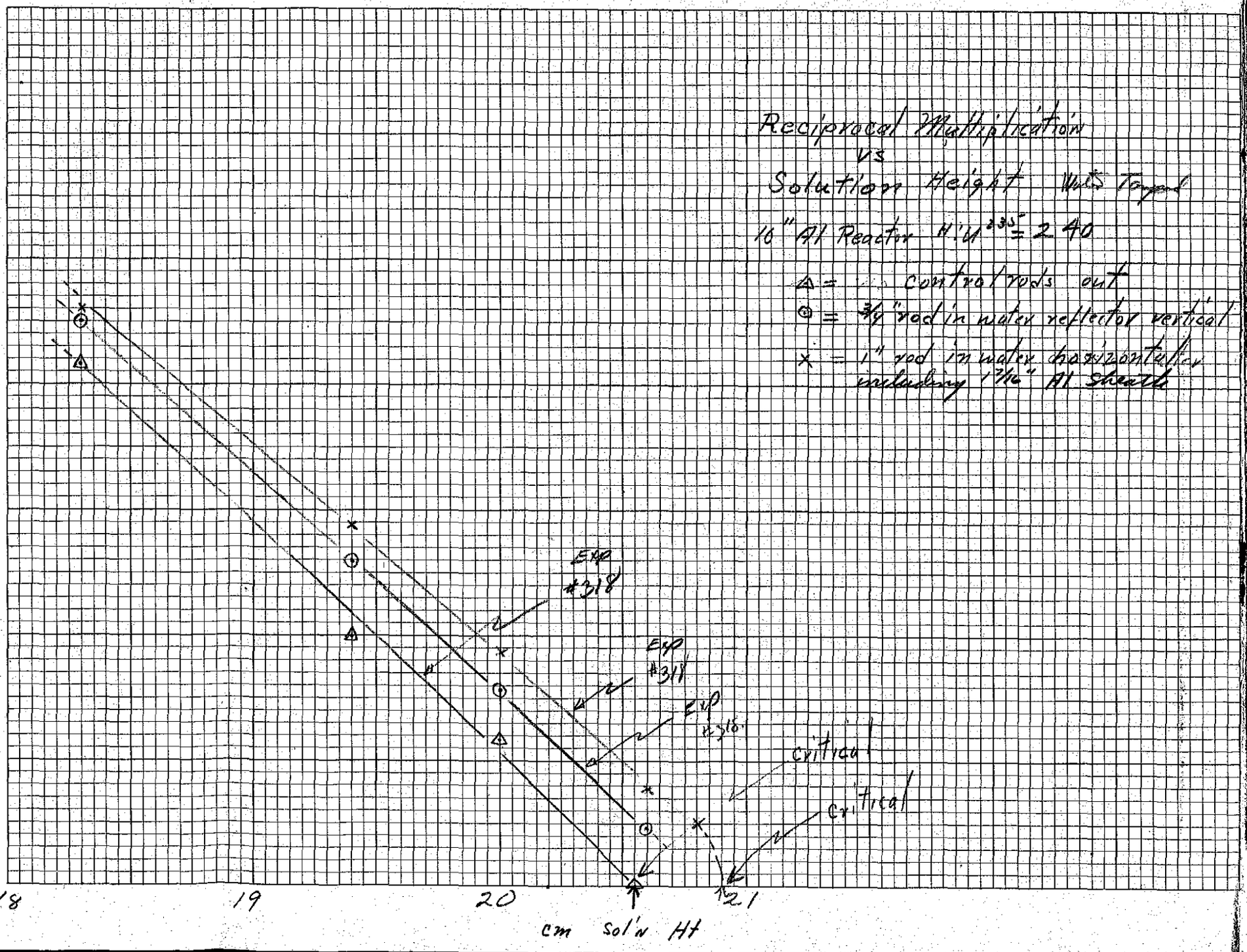
difference = 0.35 cm = with Hanford Rod IN.

Sight glass reads 0.30 cm when solution is at zero in flat bottom reactor

NOTE: Al sheath for horizontal rod introduces a void – 1 7/16" in diameter.

Summary:

	~~1" Horizontal rod in Al tube across North bottom.~~	~~3/4" Rod in Thimble~~
~~Sight glass at critical~~	~~20.55 cm~~	~~20.9~~
	No Rods + Void Horizontal	1" Rod Horizontal
Sight glass at critical	20.55 cm	20.9 cm
corr =	-.30	-.30
H_c =	20.25 cm ✓	20.60 cm
V_c =	~~10.260~~ 10.26 liter	~~10.438~~ 10.43 liter
M_c = U	~~1.149~~ 1.03 Log Kg	~~1.160~~ 1.05 1.09 Kg
M_c = X	~~1.0778~~ Kg	~~1.082~~ Kg
	V_c = 10.26	H/X 240
	M_c 1.07 Kg	
	H/X 240	



10 10/11/49

Cronin
Henry
Fox

Expt. 319 H/X = 292

10" flat bottom al. reactor Tamped -
Inst. same as previous Expt.
Source same
Object: Comparison of Values of 1/4" & 1" Control rods in #2 position, outside reactor. Also effect of void below reactor introduced by Al tube across bottom in the downfast position

1" Control rod in #2 side position - Al. tube removed from bottom | Zeros at 7 cm on scale
Remainder: Same as #318

11/11/49?

Time	Sol. Ht.	C_1	C_2	C/C_1	C/C_2	Remarks
2:55 PM	9.3 cm	7.0 6.0 6.5 } 6.5	2.5 2.5 } 2.5	1.0	1.0	
3:10 PM	14.6	10.~~5~~	7.0	.650	.357	from #6 into Calibran Norfolk 1 w
	17.4	19.5	13.5	.333	.185	
	Rod in	19.0	13.0	.342	.192	
	18.9	36.0	27.5	.180	.091	
	Rod in	32.0	24.5	.203	.102	Use #3
	19.9 Rod in	74.0	66.0	.088	.038	
		108.5	95.0	.060	.026	
	20.4 Rod in	197.0	179.0	.030	.014	
	Critical					

Conclusion: Critical at 20.4 cm on sight glass

Drainback in #6 to 8.0 from 18.8
in #8 to DV + 8.0
#7 press (#8 overflowed.

Sight glass readings.

	No rods + no void	Rod in (1st Hanford Control rod along side
	20.4 cm.	20.65
	- .30	- .30
Hc	20.10 ~~10.18~~	20.35
Vc	~~+0.185~~ Liters	10.28 ~~+0.32~~ ~~20.4~~ 188 cm
Mc-U	~~+.141~~ Kg	1.07 ~~+.08~~ Kg X
Mc-X	~~+.044~~ Kg ~~+.07 Kg~~ x 1.06 Kg X	H/X 240
	H/X 240	

11-14-49 Exp. 320

Madelin
Henry
Fox
Cronin

8" Al Flat Bottom cyl. $\frac{H}{X}$ 242 completely Water Tamped
no bottom control Rod
Source at 19.5 cm ≅ 17 cm from bottom.

Instruments	Trip Pt.	Starting Scale
#3	88 ×100	×100
#4	—	×10
#5	—	×2
#6	6.5×100	×25
#7	2¾" from tube	

Time	Sol'n #	#1	#2	c_0/c_1	c_0/c_2	
11:07	14.9	11.5	23.5			#8 MT (~~Empty~~) air drained back into cyl.
	25.4	13.0	31.0	.88	.75	filling from #7
	33.5					#7 MT
	15.1					draining into #7 18.4 cm
	~~37.0~~ 38.8	13.5	38.5			#6 MT
	18.4					draining into #6
						into #6

		#1	#2	c_0/c_1	c_0/c_2	HCR 1"	outer N.R	Inner CR	
1:20	13.4	6.0	3.0			out	out	out	Photo-multiplier trapped draining material into dump pan.
		6.0	3.0						
1:30	13.1	7.5	4.0	.82	.75	out	out	out	
11-16-49		Exp 320 Instruments & Source							Same as 11-14-49
CRONIN FOX MORFITT CALLIHAN									
10:15 A									filling D.I. from #8.
:30		~~4.0~~							#8 Empty; longer reads 5mm low; water added; fill from 7 next.
		4.25	2.5						
		5.5	3.0						
		5.0	3.0						
:55	13.4	5.0	3.0						filling from #7.
11:05	22.0	7.5	6.5	0.67	0.46	out	—	out.	
15	27.9								Photo multiplier trapped, during counting, emptying soap into dump pan.

Cleaned up ~

12 11/17/49

Exp 320 A.

CRONLIN
MACKLIN
CALLIHAN

8" Al Reactor, flat bottom, H/X = 242. Completely water tamped.

To compare control rods as follows: ① 3/4" in solution - vertical. 2¼" from bottom. ② 1" in tamper, vertical - in contact with edge of reactor.

Source at 19.5 cm = 12 cm above bottom

Run	TRIP POINTS -	Scale.
3	88 X 100	100
4	—	10
5	—	2
6	6.5 X 100	25
7	out	—

		G_1	G_2	M_1^{-1}	M_2^{-1}	Rod Positions 3/4"	1"	
9:45A	~~H=~~ H							filling from #8; #8 empty filling from 7
10:12	13.4cm	3.25 3.00 3.1	2.50 2.00 2.50 2.3					
	27	24.0	5.25 ~~8.75~~	7.5	0.59	0.31	out	out
	36	28.0	~~8.75~~ 8.25	14.25	0.35	0.16	out	out
	"		~~6.75~~ 6.25	10.25	0.46	0.22	out	in
	"		6.25	8.25	0.50	0.28	in	out.
		32.15	8.25	13.00	0.38	0.18	in	out.
		"	13.5	26.25	0.23	0.09	out	out.
11:06		"	9.5	18.5	0.33	0.12	out	in
:10		36.5	23.0	50.0	0.13	0.05	out	in
		36.4 very slightly subcritical.					out	out.
23		"	13.5	23.5	0.23	0.10 0.0	in	out.
31		—	12.0	23.0	0.26	0.10	in	out
42		36.55	Sub critical				out	out in
55		36.8	CRITICAL.				out	9cm of rod below and level.
12:03 P		39.0	Sub critical-				out	in
14		39.5	Critical				6cm rod below and level	in
20		39.5	23.25	48.25	0.13	0.05	in	out
	Sigma gamma 43.9	43.5*	CRITICAL				in	12 cm rod below and.
41	Sigma gamma = 43.7	43.3*	CRITICAL - 1" Rod out.				in	out

Some drain down through unclosed valve. V0 1D.

DRAIN INTO 6 TO ~~39.1cm~~ 39.0 as scale with 3/4" Rod in solution

Replaced 1" Rod in tamper with 3/4" rod - retained 3/4" rod in sol -

To compare values of 1" + 3/4" rods in tamper.

Cont pg 14.

** Corrected for rod displacement, calculated

Exp 321

8" Al Flat bottom Cyl. # 242

With Horizontal Control Rod (Hanford type)

Source

11/17/49

CRDR

Instruments Trip Pt. Starting Scale

Time	Sol'n Ht.	#1	#2	C_0/C_1	C_0/C_2	HCR	Outside VCR	Inner V.C.R.

11/17/49

Exp 320 A (Cont)

		C_1	C_2	M^{-1}	M^{-2}	Rod #1 *	Rod #2 *
						8cm Rod below surface of sol.	
1:35P	H = 38.5** cm.	CRITICAL					in
:50	= 38.2**	CRITICAL.				4cm rod below surface.	in
55	= 38.0	SLIGHTLY SUPER CRIT.				out	in
59	= 37.7	~~Sub~~ CRITICAL.				out	in

Summary:

Rod Position	Sight Glass at Criticality	Δ
No Rods	36.7 cm	
3/4" Rod in Tamper	37.9	1.2 cm
~~3/4" Rod~~		
1" Rod in Tamper	39.4	2.7
3/4" Rod in Solution	43.3	6.6
1 7/16" Void adjacent to reactor in Tamper 2.84 exponent	37.2	0.5 (see below)

$\frac{2.7}{1.2} = (1\frac{1}{4})$

Attached 1 7/16" ~~tube~~ Vertical tube to side of reactor - emitting thereby a void in tamper.

2:25	H = 37.6	CRITICAL.	10 cm in	out
27	= 37.35	"	22 cm in	out
31	= 37.1	Slightly Sub Crit.		

Apparently the greater void accompanying the 1" rod than the 3/4" ~~rod~~ rod is does not account for the above 2.8 exponent

Drainback - #6 #7 #8 } in 8" Reactor

23cm 22.2cm DV + 3.1 cm

Summary.	no void No rods	3/4" rod in tamper	1" rod in tamper	3/4" rod in sol'n	1 7/16" void vertical
sight glass	36.7	37.9	39.4 ✓	✓ 43.3	37.2
corr.	None	none	none	none	none ✓
H_c	~~11.90~~ ✓	12.30 ✓	~~12.82~~ 12.77 ✓	14.04 ✓	12.02 ✓
V_c	~~8.927~~ Liters	~~9.221~~ Liters	~~9.586~~ Liters	~~10.535~~ Liters	~~9.051~~
M_c U	~~1.00004~~ Kg	~~1.0327~~ Kg	~~1.0736~~ Kg	~~1.1799~~ Kg	~~1.0137~~
M_c X	~~0.933~~ Kg	~~0.963~~ Kg	~~1.005~~ Kg	~~1.101~~ Kg	~~0.945~~ Kg X
	H/X 240	H/X 240	M_c 1.33 H/X 240	1.47 Kg X H/X 240	1.26 Kg H/X 240

* Rod #1 - 3/4" rod in solution

Rod #2 - 3/4" rod in tamper (Zero = 20.5cm on scale

** Corrected for rod displacement

11/18/49.

Cronin
Henry

Source used in previous experiments replaced with source (Po-Be) PB-131 originally 9.58 c of Po or 19.3×16^6 n/sec present value approx $\frac{3.0}{\cancel{1.79}} \times 10^6$ n/sec

Source zero is 7.3 cm on scale in Control Rm.

Hanford control Rod in position – note rod and/or Al tube holding it is badly distorted – was necessary to use emery cloth to re-fit rods.

16

11/21/49

EXPERIMENT 321.

CRONIN

HENRY

CALLIHAN.

8" Al REACTOR, flat bottom, water tamped. H/X = 242.

CONTROL RODS: ① 1" ROD HORIZONTAL UNDER REACTOR, Al tube in contact with reactor
② 3/4" ROD IN SOLUTION. 2 1/4" off center.
③ 3/4" " " TAMPER. in contact with reactor.

NOTE: Al shell for horizontal rod introduces 1 1/16" void below reactor.

INSTRUMENT	TRIP POINTS	SCALES
3	88 ± 100	100
4	No	10
5	No	2
6	6 ± 1000	25
7	No	–

SOURCE AT 19.5 cm on scale = 12 cm from reactor bottom

10:55 A — Filling DV from #8 ; #8 Empty. ; filling from #6

		C1	C2	M1^-1	M2^-1	1" Rod	3/4" in sol	3/4" in tamper	
11:25	H = 12.8	8.0	6.0			out	out	out	
		6.5	5.5						
		7.5	1.5						
		7.3	6.3						
11:38	=20.1	10.5	12.0	0.70	0.52	out	out	out	
50	= 24.7	15.0	21.0	0.49	0.29	"	"	"	#6 empty; filling from 7
58	=28.6	21.5	36.5	0.34	0.17	"	"	"	
	"	20.5	37.0	0.36	0.17	in	"	"	
12:11 P	34.0	60.0	121.5	0.12	0.05	out	out	out	
13	34.0	52.0	103.5	0.14	0.06	in	out	out	
17	"	39.5	81.0	0.18	0.08	out	out	in	
27	36.0	61.5	130.0	0.12	0.05	"	"	in	
31	[illegible]	104.5	227.5	0.07	0.03	in	out	out	
37	[illegible]	153.0	323.5	0.05	0.02	out	"	"	
1:31	[illegible]	107.5	233	0.07	0.03	"	"	in	
46	36.9		NOT CRITICAL			in	"	out	
55	"		CRITICAL			out	"	45cm on scale #2cm below level of sol.	
2:02	37.2		CRITICAL.			in	"	50cm on scale 7cm below top level	
:07	"		NOT CRITICAL.			out	"	in	
	37.45		NOT CRITICAL.			out	"	in	
:23	"	223	490.5	0.03	0.01	"	"	in	
37	37.65		NOT CRITICAL.			out	out	in	
47	38.05		JUST CRITICAL.			"	"	"	
54	38.2		CRITICAL			"	at level of sol.	"	
3:00	34.7		Just CRITICAL			"	out.	out	
06	36.65		Sub Critical			"	"	"	

Exp 321 (cont).

SUMMARY: CRITICAL - NO RODS | 1" HORIZONTAL ROD | 3/4" VERTICAL ROD IN TAMPER

at Sight Glass =	36.7 cm	37.1 cm	38.1 cm.
Vc =	~~8.972~~ 8.993 Liters	9.064	9.269
Mc =	1.00000 Kg U	1.015 Kg U	1.038 Kg U
X Mc =	0.933 Kg X	0.947 Kg X	0.968 Kg X

No zero or bottom correction. ~~+1.9~~

CRITICAL VOL.	11.99 ℓ ✓	12.03 ℓ ✓	~~12.3~~ ~~12.4~~ 12.35 ✓
MASS	1.24 ~~1.20~~ Kg H/X 240	~~1.22~~ ~~1.21~~ Kg. 1.26 Kg X H/X 240	~~1.28~~ ~~1.24~~ Kg. 1.29 Kg X H/X 240

INVENTORY: #6 19.0 cm in 8" reactr. 5.4 cm in 15" reactor

#7 - 22.5 cm in 8" Reactor 6.4 " " " "

#8 - 5.5 in tDv 1.6 " " " "

Sample	%U	% X	Sp Gr.
B-4	9.604		
A-8	9.669		
C-5	9.655		
D-4	9.588		
E-7	9.566		
F-1	9.680		
G-1	9.646		
H-1	9.641		
wtd ~~avg~~	77.049		
avg	9.631	93.28	1.163

taken on same day

(= 0.0899 gm U/gm). (0.1045 gm U/cc).

$\frac{H}{X} = \frac{239}{}$ corrected for new analysis and displacement

gm/cc = ~~420~~ gm/cc

Area of 8" cyl. = 253.3 cm²
10" cyl = 506.7
15" cyl = 1140.0

bottom correct in Ht for fixed cyl (3" section)
1.45 cm
0.93
0.41

Experiment #32A

15" reactor - flat bottom. Untamped. H/X 242

Normal Control Rod set up. (3/4" rod in solution)

Source @ 7 cm from bottom

Instrument	Scale	Trips @
3	100	75 x 100
4	10	—
5	2	—
6	100/100	6 x 1000

9:30 Dead Vol. Filled from #8

9:48 Filled to 10 cm on scale Cylinder about 3 cm higher than usual

Time	Hgt.	C_1	C_2	1/M.	1/M.	Remarks
9:54	10.0	27.5	(26.0)			845 MT
		28, 27	27, 25			
		(25) 26	25, 27			
10:24	15.1	74, 71	49, "	.38	.53	from #2
10:45	16.5	95	70	.295	.37	from #3
11102	18.0	132	97	.212	.27	#3 MT
11:18	19.9	225	176, 180	.124 .145	.146	from #7
11:32	21.4	423	378	.066	.069	" "
	Rod in	352	294	.080	.085	
	Rod with 3 cm Sq #1 counter, 3 cm. Sq #2 counter.					
	22.3 (?)	1082	1011			
11:56	22.3	928	863	.030	.030	
	Rod in	594	519	.047	.050	
	Rod with 4 cm. x 4 cm.					
12:18	21.5	431	387	.065	.068	
	Drain bore to 19.8	Lunch & check of apparatus.				
2:26		228	173	.123	.150	
2:45	19.2 20.1	212	163			
2:50	21.7	794	740	.035	.035	
3:20	21.9	837	755	.033	.034	Stopped #7

No Conclusions could be drawn due to apparatus difficulties. Poor air lines on apparatus. Experiment unsuccessful.

Zero correction -21 cm

20 Carvin For Moffitt

11/25/49

Experiment #322 B Continuation of 322A

15" Reactor Flat Bottom H/X = 2.42 UNTAMPED.

Normal Control Rod Set Up. (one - 3/4" rod in solu)

Source 7cm from bottom.

Instruments	Scale	Trips @
3	X100	85
4	X10	No
5	XL	No
6	X25/100	6 X 1000
7		No.

Time	Solu. Hgt	C_1	C_2	ℓ/ℓ_1	ℓ/ℓ_2	Remarks
9:30-10:20	Brought up to 12.7 cm using #7 #8	49, 44, (41)	43, 44, (43)	1.0	1.0	# MT #7 almost MT
10:25	16.3	82	88	.50	.49	# 6 MT
10:30	19.1	159	192	.26	.22	from #4
10:37	20.2	—	—	—	—	Stopped #4
10:45	21.0	312	421	.130	.103	from #3
10:55	22.25	822	1163	A 0.05	.037	Est crit/23.0
	Rod in	530	740	.077	.058	

Rod worth between 3.5 x 4. mm.

23.05 Critical with rod @ 15cm

23.95 Subcritical with rod out.

Conclusion: Critical @ 23.0 cm ow sight glass.

→ N.B. ZERO OF SIGHT GLASS UNKNOWN AT PRESENT.

Inventory (!)

	#1	#2	#3	#4	#5	#6	#7	#8	#9
Hgt. in terms of 15"	off line	off line MT	>4cm.	>4cm.	(?)	>6	>3.6	—	(?)

Summary:

Zero correction -2.1 cm

Sight glass 23.0

Zero correction - 2.1

Bottom correction ~~0.4~~

CRITICAL HT ~~21.3~~ 20.9 cm

" Vol. ~~21.3~~ 23.8 L.

" Mass ~~2.29~~ 2.44 kg

H/X 2.40

EXPERIMENT 323

11/15/49

15" Al Reactor, H/X = 242, Tamped.
(Flat Bottomed Reactor).

Fox
Cronin
Henry
Calliman.

Inst	Trip Pts	Inst Scales.
3	85×100	100
4	NG	◆2
5	N-	1
6	6×1000	25
7	—	

Source 3cm above bottom = 13.3 on scale.
Control Rods - #1 - 3/4" dia in Sol - 2¼" off center -
#2 - 3/4" " " H₂O - control with reactor.

		C_1	C_2	Control Rods #1 out	Control Rods #2 out		
1:22 P	H = 6.35 cm	7.0	6.0				
		6.5	20				
		7.5	7.0				
		7.0	6.7				
						from # 6	
1:32	8.9	8.5	8.5	.82	.79		Both Rods out
1:42	11.6	16.5	22.0	.42	.31	stopped # 6	Both Rods out
1155	12.7	26.0	40.5	.27	.16	Both Rods out	Sol- from #4
2105	13.6	55.0	93.5	.127	.071		
		51.5	91.0	.135	.073	#2 CR in #1 out.	
		42.5	66.0	.165	.10	#1 CR in #2 out.	stopped # 4
2:20	~~Sub~~	125.0	220.0	.055	.03	#1 Rin #2 out	stood #3
	14.3	Critical				#1 CR out #2 CR at 14cm above bottom	
	~~DT~~ 14.5	Critical				#2 CR in. #1 Rod 8.5 cm from bottom	
2:45	14.5	210	390	.033	.017	#1 CR in #2 out	
	14.7	Critical				#1 CR in #2 rod 3 cm from bottom	
3:04	14.2	sub Critical				Both Rods out.	

Sightglass

Summary reading
Zero correction
Bottom correction
CRITICAL HT
Vol.
Mass.

Both Rods out	#2 out #1 Rin	#1 out #2 rod in
14.25	14.6 cm	14.4 cm
- 2.1	- 2.1	- 2.1
~~0.4~~	~~0.4~~	~~0.4~~
~~12.6~~ 12.15	12.5	12.3
~~12.6~~ cm	~~12.9~~ cm	~~12.7~~ cm
~~13.9~~ 13.85 ✓	14.25 ✓	14.07 ✓
~~14.4~~ L	~~14.7~~ L	~~14.5~~ L
[Zero correction -2.1 cm]		
~~1.40~~ kg	~~1.43~~ kg	~~1.46~~ kg
~~1.45~~	~~1.48~~	~~1.46~~
~~1.40~~	~~1.44~~	~~1.46~~ kg
1.45 kg	1.49 Kg	1.47 Kg
H/X 240	H/X 240	H/X 240

Ex 324.

Calibration For Henry Crocker

Same as Ex 323 Except – a 1 7/16" Al tube air filled on a diameter at the base of reactor. also with Cadmium

	#1	#2	C_0/C_1	C_0/C_2	
3:36	13.6	48	80.5	.146	.08 Both Rods out.
3:47	14.5	Critical – with #1 Rod 10.5 cm from bottom of Reactor			From #4
3:50	14.4	Barely Super-Critical Both Rods out			
		Critical at 14.35 ± 0.05 cm. ← Inserted Cd into Al Tube			
	14.0				into #4
4:05	14.6	Sub Critical with 1" cd rod in 1 7/16" Al tube on diameter of reactor. other rods out			stood #3
	14.7	Critical – with #1 CR 8 cm from bottom. #2 out			

Summary–

	1 7/16" void	1 7/16" Al tube with 1" cd Rod
sight glass	14.35	14.65

Drain back same as Ex 323.

Zero correction –2.1 cm

∴ 12.6 cm corrected critical height 11/28/49

11/28/49 (FC) Scoop put into 15" reactor to just come to bottom – sight glass read 2.1 cm.

Summary:

	Horizontal Al Tube	Horizontal Al Tube filled with Cd.
Sight glass at critical:	14.35 cm	14.65 cm
Zero correction	– 2.1	–2.1
Bottom ✓	~~0.4~~	~~0.4~~
Critical Ht	~~12.85~~ 12.25	~~12.55~~ 12.55
	~~+2.7~~ cm	~~+3.0~~ cm
	~~13.0~~ 13.97 ✓	
✓ Vol	~~14.5~~ ℓ	~~14.85~~ ℓ. 14.3 ℓ ✓
	~~1.46~~	~~1.55~~
✓ Mass.	~~1.46~~ kg	~~1.49~~ kg. 1.50 kg.
	H/x 240	H/x 240

24.

Exp. 325

11/28/49

12" Al Reactor Untamped $\frac{H}{X} = 2.44$

Source 10cm from bottom (18.3 on scale)

Cronin
Fox
Henry
Macklin
Callihan
S. Segal } Westinghouse visitors
Creagan }

Trip. Points

Instr.	TP	Starting scale
3	82 x 100	x 100
6	7 x 1000	x 25
4	———	x 10
5	—	x 1
7	4" from tube	———

Time	Sol'n Ht. Sight Glass Readings	⊙ #1	X #2	c/c	c/c₂	
1:40	0	—	—			Dead Vol taken from #8 earlier
1:43						Going to 18cm or empty #8
1:47	reading 5.5 (11.0) readout 11.05	~~39.5~~ 22.0 22.5	~~65.5~~ 40.5 40.0			#8 empty - fill to 11 from #7 reflectioned counters
1:58						go to 14 from #7
2:00	(14.1) 14.0	22.5 24.0	32.0 32.0	.96	1.25	
2:10						go to 18 from #7
2:10½	(16.3) 16.3	37.0	51.5	.60	.78	#7 empty
2:16						go to 18½ from #6
2:18	(18.6) 18.6	56.0	84	.40	.48	
2:23	~~(21.1)~~					go to 21 from #6
2:25	(21.1) 21.05	85.5	140	.26	.29	
2:31						go to 24½ from #3
2:34	(24.3) 24.3	168.5	322	.132	.125	
2:39½						go to 26.2 from #3
2:41	26.2	327	675	.068	.060	
2:48						go to 27.6 from #3
2:49	(27.8) 27.7					Subcritical
2:54	~~(28.15)~~					go to 28.0 from #3
2:55	(28.15) 28.1					Subcritical
2:57	(11)					add 3 mm from #3
2:59	(28.4) 28.35					Critical with rod 2.8 cm into scrap

Conclude - crit at 28.3 (sight glass)

325 continued & 326

To Drain to ~8 cm & add tamper wall!

Go to 21.1 into #3 ✓ 3:07
Go to 16.3 into #6 ✓ 3:10
Go to 8.2 into #7 ✓ 3:15
Filling Tampers ~ 3:16 - 3:30

CRITICAL AT SIGHT GLASS = 28.3 cm.
Zero correction 0.2
Bottom correction 0.7
CRITICAL HT 29.2 cm
VOL 21.30 ℓ ✓
MASS 2.23 ~~2.44~~ kg.
H/X 240

Cronin and

Exp 326 12" Al Reactor Tamped H/X ~ 244

Source set at 6 cm (14.3 on scale)

Starting Scale #3 on 100 #4 on 5 #6 on 25 #5 on 2 Counters repositioned

Time	Sight Glass (cm) rod in	rod out	7/64 x 4/m #1	#2	c/c1	c/c2	
3:44	(7.8)	7.8	22.0 21.5	20.0 20.5			Background
3:47	~~##~~						
3:49	(11.1)	11.0	39.0	56.5	.56	.36	go to 11 out of #7
3:55							
3:56	(12.5)	12.5	71.5	128	.35	.16	go to 12.5 out of #7
4:04							
4:05	(13.5)	13.5	163	333½	.124	.061	go to 13.5 " "
4:12							
4:14	(14.15)	14.1					go to 14.1 " " Slightly Subcritical
~~4~~:19							
4:20	(14.4)	14.3					go to 14.3 out of #7

10.4 rod scale Critical with 3.9 cm rod in Sonp

Conclude - critical at 14.2 cm (Sight Glass)

drain to 5.5 into #7 ✓ 4:29
dead volume into #8 ✓

#8 - DV + 9.8 cm = 9"
#7 19.5 cm

SUMMARY:
CRITICAL AT SIGHT GLASS = 14.2
Zero correction 0.2
Bottom correction 0.7
CRITICAL HEIGHT 15.1 cm
" VOL. 11.01 ℓ ✓
" MASS 1.15 ~~1.44~~ kg
H/X 240

Zero point correction ~ +0.2 cm (measured flange-to-base) with tamper empty determined by comparison with 9" cylinder 11/29/49 (JF)

26
11/29/99

Mackin
Callahan
Fox

Experiment #327

9# Aluminum Reactor #/X = 244

Tamped

Trip Points: #3 – 82 on 100 scale; #6 – 7 on 1000 scale
Instr scales: #3 – 100; #6 – 25; #5 – 2 #4 – 5

(Background source) Source: Re-zeroed at 6.8 on scale
Source set at: 16.8 on scale

Time:	M.T.					
1:55	9.3 reading	q	c	cq/c1	c/c–	#4 empty
1:56						Fill from #3
2:00	11.0	18.5, 19.5 } 19.0	14.0, 14.5 } 14.2		Blew back SG, Bldg.	
2:11	14.9	25.5	28.5	.746	.50	
—	(20.1) 19.9	57.5	90.0	.33	.158	
2:30	22.0	112.5	199.0	.169	.070	
2:35	23.4	345	663	.055	.021	stopped from #3
2:40	~~24.0~~ 24.1	crit. rod at 23 [illegible]				Filling from #7
2:50	24.1	crit rod at approx 28 cm				
	23.8	just crit. rod out				

Conclusion: Crit at 24.0 ± .1 S.G
corrected value for zero pt. 24.1

#8	D.V.	+ 9.8 cm. ≈ 9"
#7		19.5 " " "
#6		?
#5		?
#4		D.V + 9.3
#3		17.8 "

Zero correction: + 1.0 m. m.

(determined with tamper t. empty & top tamper out.)

Ep 327 (Cont'd)

Summary: CRITICAL AT SIGHT GLASS = 24.0 cm.

ZERO CORR. 0.1

BOTTOM CORR. 1.2

CRITICAL HEIGHT = 25.3 cm

" VOLUME 10.38 ℓ. ✓

" ~~MASS (10.38 x 1.12 x 0.0963) = 1.1~~ ~~(10.38 x 0.0963) = 1.00 kg.~~ 1.08

CRITICAL MASS. $10.38 \times \frac{1.163}{1.12} \times 0.0963 \times 93.3 =$ ~~1.04~~ kg

= 1.045

H/x 240

28
12/7/49

Exp. 328

Macklin

10" Al Reactor with 4 7/8" Al shells (empty) otherwise completely tamped.

For Cronin

$\frac{H}{X}$ 4 2 37

Source at 16.8 on scale (10 cm from bottom)

Instruments	starting	Trip
#3	x100	80 x100
#6	x25	6 x1000 (with BF_3 ion chamber)
#7	—	—
# Process Monitor	—	—
#5	x1	—

Solution Inventory

	B	C	D	E	F	G	H	J
10" cm	1.32	14.5	14.1	12.1	12.5	14.5	14.3	7.5

Since some water (from rinsing cyl) may be present- cyl J emptied into DV and drained back to avoid any excessive change in $\frac{H}{X}$.

Time	Sol'n Ht.	#1	#2	c/c$_o$	cx/c$_o$	
2:25	7.4					cyl H
2:40		12.5 } 12.0 H$_2$O	12.5 } 12.0			start G
	11.40	11.5 }	12.0 }			
2:52	19.8	32.5	45	.37	.267	stopped ~~#G~~
3:05	21.9	45.5	69	.264	.174	start F
3:15	25.0	95.5	158	.126	.076	
3:20	26.0	139	232.5	.086	.051	
3:30	27.0	244	418.5	.049	.029	
3:37	28.4	~~Sub~~ Critical with Rod 24 cm out				
3:41	28.2	Critical Rod 28.5 cm out				
3:44	27.95	Sub Critical Rod out				

Critical at ~~27.8~~ 28.1 ± 0.1 cm (Sight Glass Reading with rod out)

Inventory Drain back- Same as above

Sight Glass ~~Critical Ht~~ 28.1

.95

.60

Hc 29.6 cm

Vc ~~15.02~~ l ✓

Mc 1.57 ~~1.56~~ Kg.

H/X 240

Cronin
Fit
Morfitt

12/8/49

Exp 329

10" Al Reactor $\frac{\#}{x}$ u 239 6" Water Tamper. Top & Bottom Only!

Source at 10cm. from bottom.

Instruments	Starting Scale	Trip Point
#3	100	84 x 100
#4	OUT	—
#5	1	—
#6	25	7 x 1000
#7	Out	—
Proem. Monitor	(OK)	—

Time	Sub. Ht.	#1	#2	c/c$_0$	c/c.	Remarks
						#8 M.T. at 7.4cm.
8:54	12.1	(50) 51	(42) 42	1.00	1.00	from #8/#7
	Waited for completion of Janitor Service					
9:30	20.0	81.	92.	.575	.457	#7 MT @ 22.0cm
9:47	26.0	134	159.5	.373	.264	MT #6 @ 33.8
9:57	34.5	227	312.	.220	.135	from #5.
10:12	42.0	525	820	.0950	.051	
10:14	CR In	~ 240	~ 300	~ .218	~ .14	Stopped #6 @ 43.4
10:24	47.4	Not Critical Est. Crit 48.0				from #3
10:33	48.1	Not Critical Now Est Cr. 48.6				
	48.6	" " " " 48.8				
	48.9	Super Critical (Very Slightly with rod out.				

At this point we drained back to 46.0 to see @ how high a power the counter would operate efficiently in view of reflections, firing circuit, stop motor etc. The single result obtained is given below.

10:59	46.0	1048	1175	.0477	.0358
		↳ Extrapolate to 50.0	↳ Extrapolate to 55.6		

Conclusion: Critical @ 48.8 ± .1 cm on sight glass.

Bottom corr.	.93
Zero corr.	~~+.07~~ 4
	~~50.8~~ cm.
Hc corrected	50.1 cm.
Volume	25.4 l. ✓
Mc	2.65 lg x
	H/x 240

30 12/8/49

Crowell
Fix
Morfitt

Exp # 330

10" Aluminum Reactor - Two empty 7/8" shells (air) next to cylinder. Otherwise surrounded by water, ~~air~~. Top Tamp Trip Point, Instrument as in #329. Source @ 10cm from bottom.

Time	Hg.	#1	#2	c/c$_o$	c/c$_o$	Remarks
12:48	12.0	9.0, 9.0	9.0, 9.0	1.0	1.0	#8 M.T. from #7
1:03	18.0	18.0	20.5	.50	.44	
1:10	21.9	37.5	53.0	.24	.17	#7 MT
1:27	~~23.7~~ 22.7	50.0	77.0	.18	.117	from #6
1:42	24.7	455	756.0	.0197	.0119	Est. Cc 25.0
1:48	25.1	Rod @ 25 cm from bottom				
1:51	24.9	Sub. Rod out				

Conclusion critical @ 25.0 cm on scale.

Top corr. / ~~V. 22~~ "
Bottom corr. / .93 /
27.15 cm.

Critical @ 25.0 cm on scale
Top corr. .6
Bottom Corr. .9
Hc. corr. 26.5 cm
Volume 13.42 L. ✓
Mc 1.40 Kg.
H/X 240

12/8/49
Cronin
Fox
Hartig

Exp #331

H/X = 239

10" Aluminum Reactor. One empty 7/8" shell surrounding cylinder. Otherwise completely loaded, including top tamper. Trip Pour, instrument as per #326 Source 10 cm from bottom.

Use background of Exp 330

Time	Hgt (12.0)	#1 (9.0)	#2 (9.0)	C/Co (1.0)	C/Co (1.0)	Remarks
						From Exp 330
2:07	17.3	15.5	17.5	.57	.515	#8MT @ 7.2
2:16	20.0	33.5	48.0	.27	.187	Stopped #7
2:27	21.5	84.5	135.	.107	.067	From #3
2:33	22.6	Critical with rod @ 22				
2:37	20.4	Subcritical				

Conclusion @ 22.5 cm on scale

Solution Inventory same as Ex. 328

12/9/49 Filling of storage cyls M & N;

Cronin
Fox

Filled reactor (10" al. to 26.5 cm) Emptying cyls. H & G - .4 cm out of F

cyl M: 26.5 cm at start
12.3 amt in cyl
14.2 remaining

cyl N 14.2 cm at start
12.3 amt in cyl
1.9 left.

DV + 1.9 cm put back into H

Critical ~~22.5~~ on sight glass @ 22.5
Zero Corr. ~~1.2~~ .6
Bottom Corr. ~~.3~~ .9
~~24.65 cm.~~ Corrected Hc 24.0 cm

Vol 12.2 & 12.16 ✓
Mc. 1.27 kg X
H/X 240

32
11/12/49

in pit at $\frac{A}{X}$ .239 = 33,777 cc = 66.75 cm in 10" cyl.
= 3.55 Kg X
~~3.80~~ Kg 4
3.80

in ea of 8 cyl = 8.34 cm
in set of 4 = 33.36 cm

to A/X 350 total water required = 15.5 liters
~~for set of 4~~ = ~~7.6 liters~~
for 1 cyl = 1.94 liters

Distribution
9-12-49

17.6 cm
9.3
8/3 into cyl #9

19.1
10.8
8.3 cm into cyl #8

19.1
~~10.8~~
10.8
8.3 into cyl #7

21.4
12.7
8.5 into cyl #6

~~749~~

59.2 Reading
DV = 6.9
8 | 66.20
8.26

59.2	All cylinders, drain in #9
-0.9	∴ 8.3 in #9 ; drain in #8
42.6	∴ 8.3 " #8 " " #7
34.3	∴ 8.3 " #7 " " #6
26.0	∴ 8.3 " #6 " " #5
17.7	∴ 8.3 " #5 " " #4
9.4	8.3 #4
1.1	8.3 #3
1.1+DV	8.0 #2

1.94 liters added to each sample for #2 which was 1.88 liters

9-13-49

Mixing
MT #2 } 17.8
MT #3 }

1st Blowback (time right after mixing) 17.3
2nd 16.9
3rd 16.7
16.6 Roland
4th 16.55

Backgrounded counts

#1		#2	
48	50	34	40
52		37	
53		40	
49		41	

MT #4 28.7 (tamper chs.

#1	#2	c/c1	c/c2
90	100	.53	.25

12/13/49

Exp 337

Jof

10" Al Cyl H/X n 35.2 35.0 Untamped

Marklin
Cronin

Source 10 cm from bottom

Instruments	start	trip
#3	x100	78 x 100
#5	x2	—
#6	x50	6 x 1000
#7	—	8" from tube

Time	sol'n Ht	G=50 #1	G=40 #2	C_0/C_1	C_0/C_2	
1:35	28.7	90	100	.53	~~.25~~ .40	
1:40	40.85	109	115	.454	.349	# 2, 3, 4, 5 MT
	46.5					from #6
1:48	52.87	129	152	.39	.263	from #7
2:05	58.7	142	180	.35	.22	from #8
2:10	64.5	144	180	.35	.22	from #9
2:20	50.1					into #1
2:21	44.1					into #2
2:23	38.1					into #3
	32.0					into #4
	26.0					into #5
	40.52					from #1
2:45	34.2					into #9 6 cm total = 12 cm
	28.2					into #8 6 cm total = 12 cm
2:47	22.2					into #7
	16.2					into #6
	12.2					into #5

System approx not critical untamped ~~possibly critical at some large finite height.~~

Solution showed no apparent inhomogeneity - using tampers as check on sol'n ht.

34

1/13/49

Fox
Machlin
Cronin

Exp 333

10" Al $\frac{H}{x}$ = 350 completely tamped

Source at 10 cm

Instrument	Stab	Trip
3	x 100	78 x 100
5	x 2	—
6	x 50	7 x 1000
7	—	8"

Time	Sol'n Ht.	#1	#2	c_0/c_1	c_0/c_2	
2:55	12.2	5, 5, 5 } 5.0	4, 5 } 4.5 (4.5)			
3:25	16.0	7.0	7.5	.71	.60	from #2
3:30	18.3					#2 MT
3:38	22.0	21	31.5	.238	.143	from #3
3:50	24.0	88.0	146	.056	.03	from #4
3:55	24.8	Critical Rod at surface of sol'n				
3:58	24.6	Sub-Critical Rod out				

4:00 Critical at 24.7 cm ± 0.1 cm sight glass reading only

Solution Inventory

	#2	#3	#4	#5	#6	#7	#8	#9
cm in 10" cyl. =	Dr + 6cm	12.3	12	10	12	12	12	12

H uncorrected 24.7
Zero correction + 0.6
Bottom Correction 0.9
26.2 cm.

Volume V_c 13.3 ℓ 13.27 ✓

M_c ~~[illegible]~~ 0.962 Kg

H/x 352

Exp 33

12/14/49 10" Al $\frac{H}{X}$ n 350 with 20-1/8" layers of Stainless steel 2½" also top tamper surrounded by water

Machlin
Callihan
Cronin

Source at 10 cm (=16.8 cm on scale).

Instruments	Start	Trip
3	x100	20 x100
5	x1	—
6	x25	7 x1000
7	—	4" from tube

Time	Sol'n Ht.	#1		#2		C_0/C_1	C_0/C_2	
12:45	6.0 cm	4.25	4.25	5	5.0			#2 MT from #3
1:00	12.0	4.25		5.5				
		4.5		5.0				
1:18	18.0	9.5		13.0		0.47	0.38	#3 MT; following from #4.
25	21.1	16.0		24.0		0.28	0.21	
30	23.9	55.5		88.5		0.08	0.06	
37	25.2	CRIT. WITH 3cm C.R. in solution.						
40	25.0	Just CRITICAL.						
42	24.9	Sub critical.						

CRITICAL - Sight Glass = ~~24~~ 25.0 cm
Zero Corr. 0.46
Bottom Corr. 0.9
~~26.55~~ cm.
V_c Volume ~~13.3~~ 13.42 ✓
M_c 0.97 kg
H/X 352

Exp ~~335~~ 335

17/4/69 10" Al. H/x = 350

Cronin
Macklin
Callihan.

Reflector: 6" Al-O Top
6" Al-O Bottom
2½" S-Seamless - sides. (No water outside).

Inserted safety rod to evaluate "background" count -

		C_1	C_2	$C_1 - C_2$	
	H = 25.0	C_0 = 107	134	Safety rod in -	
1:55	H = 25.0	367	590	0.29	0.23
2:07	= 25.7	498	817	0.21	0.16
:08	= 27.3	Slightly super crit.			
:01	= 27.15	"	Sub	critical	
:12	= 27.0				

SIGHT GLASS AT CRITICAL = 27.1 cm.

Drainback: Zero Bottom corr. 0.4
Bottom corr. 0.9
28.4 cm.

c/s #2 #3 #4
DV+ 6cm 12cm 12cm

↓

Macklin
Cronin

Zero determination

	sightglass	Reactor
without water in tank but with 2½" of stainless	−0.4 cm	zero
with water in tank 6" deep plus steel	−0.4 cm	zero
with water in tank 3 ft deep plus steel	−0.6 cm	zero.

CRIT. H7 = 28.4 ~~L~~ Cm
Vol = 14.4 ~~L~~ L. 14.39 ✓
Mc 1.04 Kg
H/x 352

12/15/49 — Exp 336

CRONIN — 10" Al — $\frac{H}{X}$ = 350

MACKLIN CALLIHAN — Reflector: 2½" stainless — sides; no top or bottom hamper.

Source at .168 on scale. (= 10 cm above reactor bottom).

Instruments	Start	Trip Points
#3	x100	80 x 100
#5	x1	—
#6	x25	7 x 1000
#7	—	4" from tube

Time	Sol'n Ht.	#1	#2	C_0/C_1	C_0/C_2	
12:00	12.2 cm	38 / 37 / 37	41 / 42 / 41			#2 empty at 6.0 cm; Filling for #3
		(37)	(41)			
12:15	17.9	61.0	71.5	0.61	0.57	#3 Empty; Filling from #4.
21	23.0	107.0	141	0.35	0.29	
27	27.0	195	296	0.19	0.14	
35	30.2	560	920	0.07	0.04	#4 MT; from #5
43	31.7	Sub critical -				
47	32.2	Super Crit.	(Rod at 22.5 at ~ crit).			
48	32.0	" "	(" " 27 " ~ ")			
49	31.85	" "	(" " 30 " " ")			
50	31.75	Sub crit, rod out.				

SIGHT GLASS AT CRITICAL: 31.8 cm

Zero corrected 0.4

Bottom Correction 0.9

33.1 cm ✓

Volume 16.88.

1.22 ℓ

H/X 352

Exp 337

12/15/49 — 10" Al — H/X = 350

MIFFITT
MACKLIN
CRONIN
CALLIHAN

Reflector = 1½" Stainless Steel surrounded by water

Source at 16.8 on scale (10 cm from reactor bottom)

Instruments	Starting	Trips
#3	×100	80×100
#5	×1	—
#6	×100	7×1000
#7 —	—	4" from tube

Back Background assumed to be 5 for both counters from Exp 333

Time	sol'n Ht.	#1	#2	c_0/c	c_0/c_2	
2:00	17.9 cm.	4.25	6.0			
		4.25 VOID	5.0 VOID			
		(4.3)	(5.5)			Filling from 4 — Source withdrawn, placed
2:05	25.1	26.0	45.5	.165	.121	
	25.1	34.0	55	0.15	0.09	
2:25	25.9	65	110	0.08	0.05	
33	27.0	SUPER CRIT - ROD OUT				
34	26.7	SUB CRIT - " "				

CRITICAL AT SIGHT GLASS = 26.9 cm –
Zero correction 0.6
Bottom correction .9
28.4 cm.
Volume 14.42 l. 14.39 ✓
1.0 l Pg
H/X 362

INVENTORY: 1 – Empty.
at end of day — 2 – 3V + 6 cm in 10" reactor
Mixing — 3 – 12 cm
4 – 12 cm
5 – 10 cm
6 – 12 V
7 – 12 V
8 – 12 V
9 – 12 V
} See Pg 34

12/13/49

MORFITT
MACKLIN
CRONIN
CALLINAN.

Exp 338

10" Al - H/x = 350 -

Reflector - Sides - 1½" Stainless
Top & Bottom - 6" H_2O.

Source - 16.8 cm in scale = 10 cm above reactor bottom.

Background assumed from Exp 336 $C_1 = 37$; $C_2 = 41$

		C_1	C_2	M_1^{-1}	M_2^{-1}	
2:50 P	H = 26.9	243	361	0.15	0.11	Filling from 4.
	28.0	326	500	0.11	0.08	
3:05	29.5	538	853	0.07	0.05	Step from 4, filling from 5
15	31.8	Super Crit (Crit at rod = 28.5).				
17	31.6	Sub Crit Rod out -				

CRITICAL AT SIGHT GLASS = 31.7 cm -
Zero correction 0.4
Bottom correction 0.9
33.0 cm.
Volume 16.7 ℓ. ✓
421 kg
H/x 352

40

12/15/49

Exp 339

MACKLIN
MORFITT
CRONIN
CALLIHAN.

10" Al - H/X = 352 Reflector. 1½" Stainless on sides -
No water, top, bottom or sides -

Source at 16.8 cm - (10 cm above reactor bottom).

Background - from #338 $C_1 = 37$; $C_2 = 41$.

		C_1	C_2	M_1	M_2	
3:20 P	H = 31.6 cm	444	687	0.08	0.06	from #5
26	= 33.0	566	894	0.07	0.05	
* 45	= 36.0	Apparently just critical.				
52	= 36.1	Slightly supercrit.				

CRITICAL AT SIGHT GLASS = 36.0 cm.
Bottom corr. 0.9
Zero corr. 0.4
37.3 cm
Volume 18.9 ℓ ✓
M_c 1.37 Kg ✓
H/X 352

* During this interval it was noted that those on #5 Recorder chart showed slow decrease in level during 3:26 count and during the preceding interval when reactivity was estimated constant. This was first attributed to a leaky cylinder valve allowing slow drain back - but could not be conclusively shown to be this - No other cause was apparent since during the period after insertion of control rod at 3:24 the level was constant. #6 chart did not show the same action.

12/16/49 Spgr. 1.114 @ 20°C. 2 Samples were taken 9 AM.

Reg #	Sample #
830069	339A
830070	339B

INVENTORY - See pg #338

Verbal Report on 830069 0.069 g U/gsoln.

12/16/49 Exp 340

Callihan 10" Al H/X ~350 Reflector 3/4" stainless on sides
Cronin Water on sides, Top & bottom.
Marlett

14.8
Source @ ~~15.5~~ cm. 8 cm from bottom

Backgrounds for next sequence of exp

	No water	6" Water + Top Taper	Completely Tapered
#1 Counts	33.5, 33.5	36.5, 34.5 (33.8) (34.3)	3.5, 4.0 (3.75)
#2 Counts	30.5, 33.0	31.0, 32.0	3.5, 4.0 (3.75)

Instrument	Starting Scale	Taps @
#3	100	84 x 000
#4	NG	NG
#5	2	—
#6	25	8 x 000
#7 (Plastic Mon)	—	.6 ma.
#8 (Proc. Mon.	— OK	— OK

Time	Height	#1 Counts	#2 Counts	1/M	1/M²	Remarks
11:10	40.8	See above Bkgd measurements with		1.0	1.0	#2 MT @ 5.7 from #4
11:48	18.9	7.0	9.5	.53	.40	#4 MT @ 17.5
12:00	24.2	13.5 ✓	21.0, 23.0	.28	.18	from #6 ~~Stopped~~ #6
12:10	27.0	27.5	49.5	.137	.076	Stopped #6
12:20	29.0	190.	351.	.031	.007	from #8
12:30	29.4	Rod 27.0 cm off bottom		Slightly super critical @ 29.4 cm		
12:32	29.1	Subcritical with rod out. Closer to critical & have the above.				

Conclusion Critical @ 29.2 cm.
Zero Correction 0.6 cm
Bottom Correction 0.9
30.7 cm.
Volume 15.6 ℓ. ✓
1.13 Eq X
H/X 352

42 12/16/49

Exp 341

Callihan
Cipriani
Henry
Moffitt

10" Al H/x - 352/329 Reflector 3/4" Stainless steel + 6" water Top & Bottom only.
Source & Instrument same as #340
See #340 for background readings Using 33.5 for both counters

Time	Hgt	#1 Counter	#2 Counter	1/M.	1/Hr	Remarks
1:38	29.4	150.0	204.5	.223	.164	From #6
1:43	32.1	196.0	288.0	.171	.116	#6 MT @ 32.5
1:52	37.1	406	665	.082	.050	From #9
2:07	39.3	738	1050	.045	.032	
	Rod is Taper up.	225	322	.15	.104	Stopped #9
2:30	41.3	Not Critical				from #7
	41.9	Not critical				
	42.3	Super critical with rod @ 39 cm from bottom				
	42.1	" " " " @ 45 " "				

Conclusion: Critical with eight glass @ 42.0 cm.
Zero corr. 0.4 cm
Bottom corr. 0.9
43.3 cm.
Vol 21.9 L. ✓
1.59 ℓ
H/x 352

12/16/44

Experiment 342

Cadlihan
Cronin
Henry
Morfitt

10" Al 4/x 359 Reflector 3/4" stainless steel & water.
Instrument & Scale same as #340
Background 33.5 cm for both counters.

Time	Hgt	#1 Counter	#2 Counter	1/M1	1/M2	Remarks
2:58	46.1	436	713.5	.077	.047	from #7
3:08	45.15	901	875.	.037	.038	
3:15	Rod in	300, 284	NG	.111	Rd inserted 1.9 cm.	
3:25	46.9	Not critical				
3:27	48.1 *	Critical with rod @ 37 cm.				
3:29	47.9*	" " " " 40 cm				
3:30	47.7*	" " " " 42				
3:31	47.5*					
3:32	47.4					
3:33	47.3					

Critical @ 47.35 cm
Zero corr. 0.4
Bottom corr 0.9
Corrected Ht. 48.65 cm
Vol 24.6 ℓ ✓
Mass 1.78 kg
H/x 352

* Reading taken with rod at high above.

44
~~Edwin~~
Callihan
Flora (Hartford)
For
Henry
~~Morrill~~

12/19/49

Exp. 343

10" Aluminum Reactor. Reflector ½" stainless steel + Water side Top & Bottom.

Background for next experiments Source 0 @ 6.8 cm.

Inst.	Trip Pts
3	84 × 100
5	
6	7 × 1000
7	3" from source

Inventory
2 = 24 + 6 cm
3 = 12
4 = 12
5 = 0
6 = 12
7 = 12
8 = 12
9 = 12

	#1	#2	Source @
Fully tamped + S.S.	3¾, 3¾	4, 4¼	10 cm from bottom
Top + Bottom tamped + S.S.	39.5, 38	34, 35	10 cm from bottom
S.S. Reflector only	av 39	av 34.5	10 cm from bottom.

Time	Hgt	#1	#2	¼M.	¼M₂	Remarks
10:15	11.9	3.75	4.0	1.0	1.0	#2 MT at 5.5
10:40						from #3 MT 17.3
~~10:~~	19.9	7.5	11.5	.46	.35	from #4
10:50	23.4	11.5	19.5	.33	.205	
11:00	28.0	38.0, ~~36.5~~ 36.5	67.0	.102	.06	6 tamped #6
11:17	29.0	86	157	.04	.026	from #5
11:28	30.0		critical	Rod at 30 cm from bottom		
11:35	29.8		Critical	Rod not tamped down.		
11:40	29.6		Sub-critical			

Critical at 29.8 eight tubes

Corr. bottom .90
zero. .6
31.3 cm.

V_c 15.9 ℓ ✓
M_c ~~1.15~~ 1.15
H/X 352

7123

12/19/69

Calibration Marfitt Top flow Drain

Ex. 344

10" Al 1/2" Stainless Steel 6" Water Top and Bottom

Source at 10 cm from bottom

Det. same as Ex. 343 #1 #2

background = 39 34.5

Time	Ht.	#1	#2	$\frac{1}{n_1}$	$\frac{1}{n_2}$	Remarks.
12:05	29.8 cm	138	170	.283	.204	from #5
12:10	33.9	178	240	.219	.144	Stopped #5-Start #6.
12:25	40.0	290	443	0.13	0.08	~~Stop from #6~~
:35	45.0	542	880	0.07 0.05	0.04	Stop from #6, Start from #7
:45	50.0	Sub critical -				
:50	51.0	Super crit (Crit rod at 50 cm).				
:53	50.6 -	Sub crit.				

CRITICAL - SIGHT GLASS : 50.8 cm -

Bottom Correction 0.9

Zero - 0.4

CRITICAL HEIGHT 52.1 cm

Critical Vol. 26.4 ℓ ✓

M_c 1.91

H/X 352

46
12/19/49

Exp 345

Heavy Water Mockup Flow Fuel Calibration.

10" Cl Reactor - 1M x 30 - 1/2" Stainless Steel Reflector - no water.

Trip points etc same as #343

Background #1 39
#2 34.5

		C_1	C_2	#1 MT	#2	
3:15P	H = 28.2 cm.	102	126			
		101	127	0.38	0.27	Filling #5 -
1.25	= 38.3.	186	267	0.21	0.13	#5 MT; Filling #6.
20	= 45.9	321	509	0.12	0.07	
	= 50.0					#6 MT; Filling #7 -
50	= 55.4	Sub critical -				
55	= 57.2	almost critical -				
	57.6	Super crit. rod out.		(crit - rod at 54 cm from bottom).		

CRITICAL - SIGHT GLASS = 57.4 cm.
Bottom Correction = 0.9
Zero Correction = 0.4
58.7 cm.
Vol. 29.7 ℓ. ✓
M_c 2.15
H/x 352

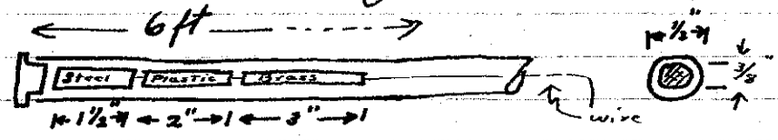
INVENTORY - 1 - MT
2 - Dv tube in 10" ref.
3 11.9
4 12
5 12
6 12 cm
7 12 cm
8 12 cm
9 12 cm

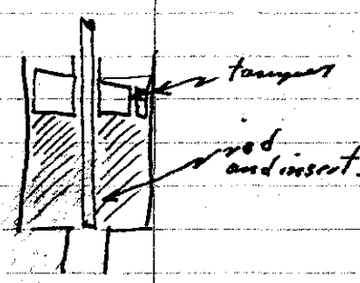
Cronin 12/22/49
Flora
Fox
Moffitt

Experiment 346

10" Al Reactor H/X ≈ 350 Completely Tamped Special Fitting

Purpose: To evaluate magnitude of perturbation introduced into proposed Hanford Reactor by Recentrant source guide tube.





wall thickness of tube = 1/16" tube is 347 stainless
inserts are 0.375" in diameter - on wire to be removable
inside diam of tube is 0.410"
plug at end is silver soldered in.

Tube held up by Safety Rod Magnet (replacing Cd rod) zero of rod = 18.5 cm scale

Part A

Rod tube completely out. usual fully tamped as Ex 333

Time	Sub Crit.	#1	#2	$1/M_1$	$1/M_2$	Remarks
1:42	9.9	40	40	1.0	1.0	#2 MT @ 5.9 cm.
1:57	~~20.0~~	13.0	18.0	.308	.22	#3 MT @ 17.4 cm
2:10	~~37~~ 23.1	37.0	61.0	.108	.066	from #4

24.7 Critical Rod at 20 cm
24.6 " " " 23 cm
24.5 " " " 25.5
24.3 - Sub-Critical Rod out

H sight glass 24.4
Zero corr. +0.6
Bottom Corr. 0.9
H_c 25.9 cm
V_c 13.1 ℓ
M_c .93

Critical at 24.4 cm on sight glass

Part B

with ~~Special~~ Special tube and Insert in Reactor. (bottom of tube at bottom of reactor

2:40	24.3+	59.5	105	.067	.038	Tube plus INSERT
2:50	24.3	71	124	.056	.032	tube IN - INSERT OUT
3:10	25.05	Critical Rod at 27 cm				
3:05	24.9	Sub Critical Rod out				

Critical at 25.0 ± 0.1 cm on sight glass

315 24.9 Sub-Critical INSERT Back in tube
25.05 Critical Rod at 25

Critical at 25.0 ± 0.1 cm on sight glass

Drainback same as Ex. 345

H_c sight glass 25.0
Zero corr +.6
Bottom corr. .9
H_c 26.5 cm.
V_c 13.42 ~~13.4ℓ~~
M_c 0.97
H/X 352

48 Cronin Flora For Moffitt

H/X ~ 350

Experiment #347

12/23/49

10" Aluminum Reactor - 4 7/8" shells of $UO_2(NO_3)_2$ as side reflector. No top or bottom reflector.

Source 10 cm from bottom 16.8 on scale.

Instruments	Set at	trips at
#3	10	78 X 100
#4	NG	—
#5	#1	—
#6	#25	.7 X 1000
#7	—	6" @ .7

Background

Time	Soln Ht.	#1	#2	1/M	$1/M^2$	Remarks
9:49	12.2	(26.25, 26.25)	27.0	275	1.0	1.0 from #2 — MT @ 5.8
9:57	18.1	47	49.5	.55	.55	#3 MT
10:05	23.0	81.5	100	.32	.275	from #4
10:22	26.0	137	184	.19	.147	stopped #4
10:32	28.0	230	332	.113	.081	from #5
10:45	30.0	843	1061	.03	.025	
10:58	31.0	Critical at 25 cm Rod from reactor bottom				
	30.8	Slightly super critical				
	30.7	slightly sub-critical				

System Critical at 30.75 cm on sight glass.

Zero Corr. 0.4

Bottom Corr. 0.9

H_c = 32.05 cm

V_c 16.2 ℓ ✓

M_c 1.17 Kg X

H/X 352

12/23/49 — Exp. 348 — H/X ∞ 350

Cronin
Flora
Fox
Henry
Morf. II

10" Al Reactor — 2 shells of $UO_2(NO_3)_2$.

as side reflector — no top or bottom reflector

Source 10 cm from bottom 16.8 on scale

Trip pts. same as #347.

Background = same as exp. #347

Time	Soln. Ht.	#1	#2	M_1	M_2	Remarks
1:25	17.6	64.5 ~~31~~ 32 64.5	61, 61	~~.70~~ .403	~~.80~~ .44	#4 empty @ 26.5
1:40	27.8	188	246	~~.14~~ .139	.109	
1:50	31.1	357	509	.073	.053	
	31.1 Rod in	241	306	.108	.088	
2:02	32.1	618	912	.042	.030	
2:13	34.0	Subcritical w/ rod out.				
2:17	34.5	" " " " (slightly)				
2:20	34.95	Critical w/ rod at 30 cm.				
2:22	34.6	Subcritical w/ rod out				
2:23	34.75	" " " "				

System critical at 34.85 cm. on sightglass.

Sight Glass 34.85
Zero Correction 0.4
~~Bottom Corr.~~ 0.9
H_c = 36.15 cm
V_c = 18.3 ℓ. ✓
M_c = 1.33 kg X
H/X 352

H/X ∞ 350

Exp #349

Cronin For Morfitt

10" Aluminum Reactor 1 shell of $UO_2(NO_3)_2$ as side reflector. No top or bottom reflector. conc. Source 13 cm from bottom 19.8 m scale.

Instrument	Original Setting	Trips @
3	20	80 x 100
4	NG	—
5	1	—
6	50	.8 x 1000
7	—	.6 /

Time	Soln. Hgt.	#1	#2	1/M.	1/M.	Remarks.
11:48	15.3	50	41.5	1.0	1.0	#2 MT @ 6.5
11:57	25.1	117	124	.43	.33	#3 MT @ 20.
12:03	30.1	178	203	.28	.205	#4 MT @ 29
12:14	37.9	390	536	.128	.08	from #5
12:20	42.9	1004, 1024	857, 854			#5 MT @ 40.7
Rod in	42.9 +	468	448			
12:25	46.4	Critical with rod @ 37.0				
12:30	~~45.8~~ 46.0	Critical with rod @ 40.				
12:31	~~45.8~~ ~~46.8~~	Just Critical Rod out				
12:32	45.65	Subcritical.				

Conclusion. Critical @ 45.8 cm no night glow.
Zero Corr. 0.4
Bottom corr. 0.9
Drainback as above 47.1 cm

$H_c = 47.1$ cm.
$V_c = 23.9$ ✓
$M_c = 1.73$ kg ✓
H/X 352

~~LLLL~~

McSlenkon for Cronin

Exp #350

10" Aluminum Reactor 1 shell of $UO_2(NO_3)_2$ as solution

The tamper concentration is approximately ½ that of the previous experiment. No Top & bottom reflector.

Source at 10 cm from bottom

Instruments	Starting	Trips
3	x 20	80 x 100
4	NB	—
5	x 1	—
6	x 25	6.5 x 1000
7	—	4" from tube (½ mg source

Time	Sol'n	#1		#2		$\frac{1}{M_1}$	$\frac{1}{M_2}$	
9:00	120 40	39.5 41.0 39.5	40	34.5 33.0 35.5	34.0			#2 MT at 6 cm
9:15	18.0	66.5		58		.60	.58	#3 MT at 17 cm
9:30	28.5	151.0		169		.26	.20	#4 M at 29.1
9:38	34.0	253		318		.16	.11	from #5
9:55	40.0	691		992		.058	.034	"
10:00	40.00	334		431		.12	.079	Control Rod in
10:12	43.7	Critical Rod at 34 cm						from #6
10:13	43.5	Critical Rod at 39						
10:14	43.3	Sub Critical						

Critical at 43.4 cm ± 0.1 cm on sight glass

Drain back into cylinder as taken out.

Sight glass 43.4 cm
Zero Corr. 0.4
Bottom Corr. 0.9
H_c = 44.7 cm ✓
V_c = 22.4
M_c = 1.64
H/X = 352

52

McLendon
Cronin
Fox

Expt 35-1

H/X = 350

10" AL Reactor
2-1" shell of $UO_2(NO_3)_2$ @ ~ 12% conc.
no other reflector

Source at 10 cm
Starting scales #6 - 25; #5 - 1; #3 - 20

Time	Ht	C_1	C_2	$1/c_1$	$1/c_2$	
1:25	12.2	32.0, 31.0 } 31.5	38.0, 39.0 } 38.5			#2 Empty at 6 cm
1:35	17.6	59.0	69.5	.53	.55	3 Empty at 17.0
1:40	23.0	107.0	134.5	.295	.285	
1:48	26.9	192.5	239	.22	.16	
1:55	"	182.0	242	.173	.16	
2:00	31.0	424	592	.074	.065	
	" rod in	271	35-6	~~.108~~ .108	.116	
2:13	34.5	crit. rod at 33				

34.3 sub. crit with rod out

Conclusion: crit at 34.4 ± .05

Drumbach ~~—~~ as filled

Sight Glass	34.4 cm
Zero Correction	0.4
Bottom Correction	0.9
Hc	35.7 cm
Vc	18.1 ℓ ✓
Mc	1.31 Kg X
H/X	352

For Mc London Cronin

Exp. 352

10" Al Reactor with 4 shells of $UO_2(NO_3)_2$ @ 129o conc

no other reflector

Starting condition same as Ex 351

Time	Ht	#1	#2	1/M.	1/M.		
Cm. 3:05	10.9	25.0 25.5	23.0 23.3				
~~3:10~~	~~10.~~	26.0	23.5				
3:20	18.2	46	41.5	.55	.56	#3 MT	at 17.0 "
.0 3:24	24.0	89	74	.28	.25		"
3:30	26.0	125	144	~~.09~~	.18	Stopped #4	"
3:40	29.1	295	376	(.20) .086	.062	from # 6	"
3:45	31.5	Critical Rod at 25 cm				" " "	"
3:46	31.3	" " " 27 "				into #6	
3:47	31.1	Sub Critical Rod out					

Critical at 31.2 ± 0.1cm (sight glass reading)

Drain back same as taken out.

Sight Glass	31.2 cm
Zero Correction	0.4
Bottom Corr.	0.9
Hc	32.5 cm
Vc	16.5 L.
Mc	1.20 Kg
H/X	352

54

12/30/49

Fox

Henry
Crowe
Moffitt

Expt 353 H/X = 359

16" Al Reactor

1 shell of H_2O tamper

No top or bottom reflector.

Trip points: PM – 5" ; #3 – 85 ; #6 – 60 on kN

Source at 10 cm. (16.8 on scale) Starting Scales – Most sensitive

Time.

	HV.	C_1	C_2	C_{10}/C_1	C_{20}/C_2	Remarks
12:46 PM	12.2 cm	49.5 } 49.5 49.5 }	36.5 } 36.5 36.5 }			#2 empty at 6.0 #3 " at 16.9
12:58 P.M.	17.9 "	81.0	63.0	.61	.58	
1:02 "	23.9 "	131.0	112.0	.38	.31	
1:10 "	27.9	177.0	173.0	.28	.21	#4 " at 29.3
1:17	36.0	436.0	489.0	.11	.075	Stopped ~~#6~~ #5 at 38.
1:35	40.0	1019.	1035	.049	.035	
1:40	40.0 (Rod in)	432.0	479.0	.11	.076	
1:53	42.5	Super critical; critical with rod at 34.0				
	42.1	" " " " "				at ~~34.0~~ 35.0
	42.8	" " " " "				" 38.0
	42.5	Sub-critical				

Conclusion: Critical at 42.6 cm ± 0.1 mm

Drain: into #5 @ 38.0
" #5 " 29.3
" #4 " 17.5

Sight Glass 42.6 cm.
Zero Corr. 0.4
Bottom Corr. 0.9
H_c 43.9 cm
V_c 22.2 ℓ ✓
M_c 1.61 kg
H/X 352

$\frac{H}{X} = 350$

12/30/49 Exp. 354

Henry Morfitt Cronise

10" Al Reactor 2 shells of H_2O no other tamper top or bottom

Starting conditions same as Exp. 353

Time	Nt.	1		2		C_{10}/C_1	C_{20}/C_2	Remarks
2:20	11.8	37.5	37.5	32.5	32.5			#3 MT #2 MT @ 17.5
		37.5		33.0				
2:36	20.1	95.0		81.0		.395	.40	
2:47	25.0	167		161		.22	.20	
2:56	30.0	396		432		.095	.075	#4 MT @ 29.4
3:05	32.4	990		1093		.038	.030	
3:06	34.2	Critical Rod at 28cm						
3:15	34.0	Critical with rod out.						
3:16	33.95	Subcritical with rod out						

Conclusion: Critical @ 34.0 cm ± 0.05 in spaced plane.

Zero Corr. 0.4

Bottom Corr. 0.9

H_c 35.3 cm

V_c 17.9 ℓ ✓

M_c 1.30 Kg

H/X 352

12/30/49

Henry
Moffitt
Cronin

Exp. ~~358~~ 355

10" Al Reactor 4 shells of water no other tamper
Starting conditions same as Ex. 353

Time	~~Hf~~	#1	#2	$\frac{1}{m}$	$\frac{1}{m_2}$	
3:30	13.1	31 } 30 29 }	27 } 26.5 26 }			
3:40	25.0	138	131	.222	.20	413 m 217.0
3:45	28.1	281	287	.107	.092	stopped #4
3:50	31.0	Sub Critical Rod out.				
4:00	31.7	Critical Rod 29.5 cm				
	31.6	Critical Rod at 31 cm				
	~~37.4~~ 31.3	Critical Rod at 32				
	31.1	Sub critical Rod out				

Critical at 31.2 ± 0.1 cm on sight glass.

Drainback —

#5	#4	#3	#2
12cm	11cm	12cm	

Sight Glass	31.2 cm.
Zero corr.	0.4
~~Bottom~~ corr.	0.9
Hc	32.5 cm
Vc.	16.5 ℓ ✓
Mc	1.20 kg
H/X	⊙352

1/4/50

McLendon
Moffitt
Cronin

Exp 356

15" Al Reactor H/X = 359 Completely water tamped

Source at 5 cm (11.8 on scale)

Instruments	Trip	Start
3	80 x 100	x 10
5	—	x 2
6	5.6 x 1000	x 25
7	4" -	4" from tube

Inventory	#2	#3	#4	#5	#6	#7	#8	#9
	Dirt 3	5.3	4.9	5.3	5.3	5.3	5.3	5.3

Time	Hf	#1	#2	$\frac{1}{M_1}$	$\frac{1}{M_2}$	
10:30	6.0	4.0 avg	3.5 avg	1.0	1.0	#2 MT at 3.3
10:50	10.0	6.5	7.5	.61	.46	#3 MT @ 7.5
11:00	12.5	12.5	17.0	.32	.21	#4 MT @ 12.6
11:09	14.3	~~13.5~~ 14	77.0	.092	.045	from #5
11:20	15.0	Supercritical with Tamper 5 mm.				
11:22	14.9	" " 3 mm.				
11:24	14.8	Subcritical				

Critical @ 14.85 ± .05 cm. on sight glass

Zero corr. -.8

Bottom corr.

Sight Glass Hf. 14.85

zero +.8

Bottom ~~-.7~~ -.4

~~16.35~~

Hc ~~14.85~~

Vc ~~17.0~~

14.85
-.8
+.4
14.45

16.57 ✓

Mc 1.20

H/X 352

58 1/4/50

Exp 357

Groves McLendon Moffitt

15" Aluminum Reactor H/X = 359 No reflector

Source @ 14.8 8 cm from bottom.

Instruments & Inventory as per 356

Time	Hgt.	#1 (as 120)	#2	1/M1	1/M2	Remarks.
12:10	10.1	10.0, 10.5	25, 26	1.0	1.0	243 M.T. 4 M2 @ 12.8
12:17	~~19.2~~	(10.5)	(25.5)			5 MT @ 19.2
12:20	19.2	50.5	109	.208	.234	
		Lunch				
1:20	21.1	84.5	~~#5~~ 184	.13	.14	from #6
Rod in		70	158	.165	.162	
1:31	23.0	171	445	.061	.057	Stopped #6
1:37	23.9	334	943	.030	.027	
		180	500			
1:42	25.0	Rod @ 16.0				
1:44	24.9	" @ 17.5				
	24.8	" @ 19.0				
1:46	24.65	Critical with rod out.				

Conclusion: Critical @ 24.65 on sight glass.

Solution zero measured on drain back—

Soln zero @ 1.0 cm on gage. Temperature expty.

Bouy correction 2mm.

∴ Soln zero @ 0.8 cm. Temper tank full.

Sight gl. ht.	24.65
zero	−1.00
Bottom	+.4
Hc	24.05
Vc	27.4 ✓
Mc	1.99 kg
H/X	352

1/4/50

Cronin
McLendon
Moffitt

Exp 358

9" Aluminum Reactor H/X = 359 Complete Tamper

Source @ 17.5 10 cm from bottom. Trip Points as per 356

	Inventory	#2	#3	#4	#5	#6	#7	#8	#9
		D.V. 7.4	14.5	13.5	14.5	14.5	14.5	14.5	14.5
Time	Hgt.	#1	#2		1/M	1/M	Remarks		
3:20	12.7 (Tamper 27.1)	~~#5~~ 10	3.5, 4				#2 MT at 7.4		
3:40	~~#~~ 21.6	18	9.5		.55	.4	#3 MT at 18.5		
3:46	26.7	31	16.5		.32	.23	#4		
3:52	33.0	227	136		.044	.028	#4 MT		
4:04	34.3	Critical Rod at 29 cm					#5		
4:06	34.1	Critical Rod at 31.					into #5		
4:10	33.9	Critical Rod at 46					into #5		
4:12	33.7	Sub Critical Rod out					into #5		

Critical at 33.8 ± 0.1 cm

Drain back as taken out. Sight Glass reads +0.2 cm. at zero with empty tamper tank

sight glass Ht	33.8
Zero	0
Bottoms	1.2
Hc	35.0
Vc	14.36 l
Mc	1.04 kg
H/X	352

60 1/6/50

Exp # 357

Cronin
McLendon
Morfitt

12" Aluminum Cylinder Tamped H/X = 357

Source @ 15.5 8cm from bottom.

Instrument	Trip	Start
3	80x100	x10
4	NG	—
5	—	x2
6	6x1000	x25
7	.73	—

Inventory

#2	#3	#4	#5	#6	#7	#8	#9
DV+4.2	8.2	7.5	8.2	8.2	8.2	8.2	8.2

Time	Hgt.	#1	#2	1/M	1/M²	Remarks
10:37	10.0	5.0 ~~3.4~~ 4.5 (4.75)	4.5, 4.0 (4.25)	1.0	1.0	2 MT, #3 MT @ 10.0
10:55	15.0	14.0	18.5	.34	.235	from #4
11:03	16.6	36.5	50.0	.13	.085	stopped to Est Cr. 17.5
11:13	17.9	Critical with rod @ 12.0				
11:17	17.7	~~Super~~ Critical, rod @ 15.0				
11:20	17.5	" " " 21.5				
11:24	17.45	Subcritical with rod out				

Conclusion Critical @ 17.50 cm on Sejet glass

zero cor.	1.25
Bottom	.6
Hc =	19.35
Vc =	14.12 ✓
M_c	1.02
H/X	352

7/5/50

Cronin
McLendon
Morlit

H/X 359

Exp. # 360

12" Aluminum Cylinder Untamped

Source & Instruments as for #359

Time	Soln.	C_1	C_2	$1/M_1$	$1/M_2$	
11:30	17.8	45.5	59.	1.0	1.0	Nominal 3G
11:34	20.0	60	78	.75	.75	from #5
11:42	25.0	105	162	.43	.365	Mid #4
11:50	28.6	176	294.5	.26	.20	emptied #5
12:00	32.0	378	696	.12	.085	
	Rod in	220	370	.21	.16	
	35.0	Subcritical				
	35.4	Super critical rod				
	35.2	Critical with rod out				
	35.1 +	Subcritical				

Conclusion: Critical @ 35.2

#1	#2	#3	#4	#5	#6	#7	#8	#9
MT	DV.	8.0 cm	8.0 cm	8.0 cm.	8.0 cm	8.0 cm	8.0 cm	7.8 cm

Borg correction 3 mm.

Light glass Ht	35.2
Zero cn.	1.0
Bottom "	.6
	~~37.05~~ 36.8
Hc	
Vc	~~27.0~~ 26.8

Mc 1.94 Kg

H/X 352

Wgt. of $Bi_2O_2CO_3$ in shells

Shell	Tare	Gross	Net
			49.0
18A	19.0	~~68.0~~ 68.0	[redacted]
18B	19.0	~~68.5~~ 68.5	[redacted] 49.5

No shell	Cross Section area cm^2	
10 A + 10 B	197 cm^2	} See p 97 Book 28.
12A + 12B	233	
14A + 14B	268.5	
16A + 16B	302.	
18A + 18 B	817.[redacted]	"OD" 22 5/8" "ID" 18 3/4" Thickness 3 7/8" Actual Measurements. Not from print. Corrected for wall thickness.

1/6/50

Cronin
McLendon
Morfitt

Exp #361

12" Aluminum Reactor surrounded by 3-7/8" $Bi_2O_2CO_3$ dry shells + one 1 7/8" shell. H/X 359.

Source @ 16.5 cm 9 cm. from bottom.

Instruments as per #359

Time	Soln.	C_1	C_2	$1/M_1$	$1/M_2$	Remarks
3:25	11.0	26, 23, (25.)	38.5, 48. 39. (39)	1.0	1.0	#6 M.T.
3:30	17.1	42.0	72	.60	.54	
3:42	23.1	106.	215	.23	.18	from #7 7 M.T.
3:48	25.5	166	330	.15	.12	#8 M.T. @ 28.3
3:54	29.05	413	824	.06	.05	
	31.5	Sub Est. crit 31.8				
	32.0	Super critical Rod @ 30.				
	31.8	Subcritical				

Conclusion: Critical at 31.9 cm.

Decided to eliminate experiment of 2 shells of $Bi_2O_2CO_3$ because only 3.3 cm difference in hgt. between this exp + exp #359.

Inventory See #360

st. plan Ht	31.9
Zero	1.25
Bottom	.6
Hc	~~33.75~~
	33.5
Vc	24.4 ℓ
M_c	1.77 kg
H/X	352

64

1/6/50

Exp #362

Cronin
McLendon
Merritt

12" Aluminum Reactor Surrounded by one - 7/8" shell of Bi_2O_3 CO_3 (data p 97 bx 28) #/x = 359

Source @ 165 cm 9.0 cm from bottom.

Instruments	Trip	Start
3	82x100	x10
4	NG	—
5	—	x2
6	5.4x1000	x25
7	.7	—

Time	Soln Hgt.	#1	#2	⊙ 1/M	x 1/M	Remarks.
9 40	11.1	24. ✓	33.0 ✓	1.0	1.0	#2, 3 MT.
9 41	18.0	52.	47.0	.46	.70	#4 MT. @ 16.5
9 52	23.1	84	105	.29	.31	#5 MT @ 26.0
9 57	27.1	138	204	.17	.16	from #6.
10 02	31.0	318	554	.076	.059	
	Rod in	190	299	.13	.11	
	Rod in	280	410	.086	.081	
Newcastle 10 14	32.6	776	963	.031	.024	Stepped #6 from #7
	34.7	Crit Rod @ 22.0 cm.				
10 22	34.3	" " @ 25.0				
16 30	33.9	" " @ 29.0				
	33.7	Subcritical Rod Out.				

Conclusion: Critical at 33.8 cm

Inventory. See Exp 360

st-glass	33.8
Zero.	1.0
Bottom	.6
Hc	35.4
Vc	25.8 ℓ ✓
Mc	1.87 Kg
H/x	352 ✓

1/6/50

McLendon
Manfitt
Calkins
Cronin

Exp. 363 H/X = 359

12" Al Reactor with one 7/8" shell of water
no other reflector

Source at 16.5 cm (9.0 cm from bottom)

Instrument same as Exp ~~356~~ 362

Time	Sol'n Ht.	#1	#2	γ_{M_1}	γ_{M_2}	
2:25	11.3	31	39	1.0	1.0	#2, 3, MT
		31	39			
2:32	17.9	64	64	.485	.60	#4 MT of 18.
2:37	22.1	125	155	.25	.25	
2:45	24.0	201	200	.154	.195	
2:55	~~25.5~~	203	289	.153	.135	
2:58	25.5	378	601	.082	.065	
2:59	Rod in	220	300	.14	.130	
3:06	26.15	620	1003	.05	.039	Start #6
	Rod in	300	430	.103	.099	
	27.1	Rod at 25.5				
	26.9	Subcritical Rod at 0				

Critical at 27.0 ± 0.1 cm

	27.0
zero	1.0
Bottom	.6
Hc	28.6
Vc	20.9 ✓
M_c	1.52
H/X	352

66 1/9/50

Exp. 364

Grumi
Hacker
Moffitt
Henry

12" Aluminum Reactor surrounded by 2 7/8" shells of water as side tamper. No other reflector H/X = 359

Instruments	Stop @	Trips at
3	x10	84x100
4	NG	NG
5	x2	
6	~~x25~~ out	out.
7		3½° avg ~ .7 rad/sec.

Source @ 15.5 cm 8 cm from bottom.

Time	Hgt.	#1	#2	1/M1	1/M2	Remarks
10:50	11.2	28. ✓	29.0 ✓	1.0	1.0	#2 #3 MT
11:05	18.7	78.0	84.0	.36	.34	Turned 4
11:12	22.0	185.0	246.0	.15	.12	#4 MT at 12.8
11:16	23.0 With Rod	192.6	250.0			Users
11:18	23.0 No Rod	302.0	426.0	.09	.068	
11:24	24.1	104	856	.03	.03	
11:28	25.1	Rod at 13.0 = 12.1 cm of rod - ~~Super~~ Critical				
11:30	24.9	Critical with rod at 14.0 (10.9 cm. of rod)				
11:32	24.7	" " " " 16.0 (8.7 " " ")				
11:33	24.5	" " " " 21.0 (3.5 " " ")				
11:35	24.35	Subcritical				

Conclusion: Critical at 24.4

zero c.	1.0
Bottom =	.6
Hc	26.0
Vc	19.0 ✓
Mc	1.38
H/X	352

1/9/50

Expt. 365

Cronin
Macklin
Moffitt
Henry

12" Al. Reactor surrounded by 3 - 7/8" shells + 1 - 1 3/8" shell of water. Other conditions same as #364
H/X = 359

Time	Ht.	#1		#2		C_1/C_1	C_2/C_2	Remarks
11:52	10.8	16.0 16.0	16.0	15.0 15.0	15.0	1.0	1.0	
11:57	17.5	35.0		33.0		.46	.46	
12:03	22.1	147.0		189.0		.11	.08	
	Withdrawn	95.0				.17		
12:12	23.3	Subcritical						
12:13	23.2	Subcritical						

Conclusion: Critical at 23.25

Drain back (see Expt. 360)

Sight glass H_a	23.25
Zero	1.0
Bottom	.6
H_c	24.85
V_c	18.1 ✓
N_c	1.31
H/X	352

1/9/50

Expt. # 366 — No star reflector

Cronin
Moffitt
Macklin
Henry

12" Al. Reactor. 1-$\frac{7}{8}$" shell filled with BiO_2CO_3 slurry* (6.8gm/cm3)
Other factors same as #364
H/x ≃ 359

Time	Diff.	#1		#2		C_{10}/C_1	C_{20}/C_2	Remarks.
1:33	10.0	30.0	30.0	37.0	36.5	1.0	1.0	
		30.0		36.0				## MT at 18.0
1:37	18.5	76.0		77.0		.39	.48	from # 5
1:44	23.0	161.0		208.0		.17	.18	
1:48	25.0	290.0		452.0		.10	.08	
	" Rodin.	195.0		275.0		.15	.13	
1:53	26.5	917.		971.		.03	.04	
	Rodin	340		500		.09	.08	
2:02	27.5	Critical with rod at 18.0 (9.5 cm. of rod)						
	27.3	" " " " 20.0 (7.3 " " ")						
	27.1	" " " out						
	27.0	Subcritical						

Conclusion: Critical at 27.1
zero 1.0
Bottom .6
Hc 28.7

V_c = 20.9 ✓
M_c 1.52
H/x 352

*See p 70

1/9/50

Exp #367

Crowin — 12" Al reactor 3-7/8" shells $Bi_2O_2CO_3$ slurry *

Mackrin + 1 1 3/4" shell with $Bi_2O_2CO_3$ slurry. No other reflector.

Morfitt Source & entrance per #364. Total Bi Cubes - 8 1/2"

H/X ≈ 359

Time	Sol. Hgt.	#1	#2	C_1/C_1	C_2/C_2	Remarks
4 56	10.6	18.0	17.0	1.0	1.0	#2, 3, MT.
5 04	17.8	42.0	40	.43	.43	MT. @ 1870
5 10	22.0	197.	239 ~~197~~	.09	.071	
5 14	23.4	Critical with rod @ 15.0				
5 16	23.2	" " " 20.0				
5 20	23.0	Slightly subcritical with rod out.				

Conclusion: Critical @ 23.1 cm. on sight gage.

zero	1.0
Bottom	.6
Hc	24.7
V_c	18.02 V
M_c	1.31 Kg X
H/X	352

Drawback per #360

* See p 70

70
1/10/50

Bi- Slurry Data.

Used in experiments 366, 367, 368.

Shell #	Tare lbs	Gross lbs	Net lbs	Area cm^2	Depth Slurry cm	Volume cc	ρ slurry g/cc slurry	ρ_{Bi} g/cc slurry	ρ_{H_2O} g/cc sl.
12A	11.0	~~45.5~~	34.5	116	70.2	8140	1.92	.879	.847
12B	11.0	47.0	36.0	116	76.4	8860	1.84	.843	.811
14A	12.5	49.5	37.0	134	68.0	9110	1.84	.843	.811
14B	12.5	52.0	39.6	134	73.1	9800	~~1.83~~ 1.83	.838	.807
16A	14.0	55.0	41.0	151	65.0	9810	1.90	.870	.838
16B	14.0	57.0	43.0	151	67.7	10220	1.91	.875	.842
18A	19.0	134.5	115.5	408	72.0	29400	1.78	.815	.785
18B	19.0	152.	133.0	408	82.4	33600	1.80	.824	.794
						Ave.	1.85	.848	.817

Deviation ± 3.8%

Slurry was made up on Wgt basis:

19.0 lbs $Bi_2O_2CO_3$
+ 15.0 lbs H_2O
34.0 lbs.

Wgt % $Bi_2O_2CO_3$ $\frac{19}{34}$ = ×55.9 %
Wgt % Bi .820 × $\frac{15}{34}$ = 45.8 %
Wgt % H_2O = 44.1 %

} Item data used to obtain last two columns

Ave. g slurry/cc. 1.85
Ave. g $Bi_2O_2CO_3$/cc. 1.034
Ave. g Bi/cc 0.848
Ave. g H_2O/cc 0.817

7/11/60

Exp #368

Cronin
McLendon
Moffitt

12" Al reactor 3-7/8" shells + 1-1 3/4" shell, all filled with $Bi_2O_2CO_3$ slurry. See p 70 for concentration. No other reflector. Source @ ~~16 cm~~ ~~cm~~. 16.5 cm 9 cm from bottom.

H/x ≈ 500/493

Instrument	Start @	Trip @
3	X10	79X100
4	NG	NG
5	X2	—
6	X25	6X1000
7	—	0.72 @ 4"

Time	Hgt.	#1	#2	C_{10}/C_{5cm}	C_{20}/C_2	Remarks.
9:30	Began filling to cover source. Took ~~5cm~~ from each cyl on way up: A - ~5 cm B - 5 cm C - 2 cm D - 2 cm. E - 2 cm F - 2 cm.					
9:47	12.3	13.0, 14.0 (14.5)	(16.0) 14.5	1.0	1.0	Critical on above. 2 cm ca from G,H,J. 2 cm ca from J,H,G
10:18	18.5	23.5	23.0	.60	.70	
10:27	24.5	55.	74.5	.255	.225	from F
10:34	26.5	100	157	.14	.106	from E
10:44	28.0	307	521	.046	.046 .037	from D
10:50	29.0	Critical with rod @ 20.0				
	28.8	" " "				
	28.6	Slightly super with rod out.				
10:52	28.5	Subcritical.				

Drainback as above.

Conclusion Critical at 28.55 on sight glass.

Zero C. 1.0
Bottoms .6
Hc 30.15

Vc 22.0 ℓ. ✓

Mc 1.17 Kg
H/x 493

72

7/11/50

Exp #369

Crowin
McLandow
Moffitt

12" Al reactor Unterfeed H/X = 500

Source @ 17.5 10 cm from bottom.
Instrument Same as 368.

Time	Soln Hgt.	#1	#2	C/C10	C/Cm	Remarks
12:50	10.0	14.5	39.5			
		14.5	39.0			
12:53	13.5	16.0 (16.5)	(26.0), 26.0			#1 - MT
1:00	18.1	27.0	39.0	.61	.67	#2 - MT @ 17.5
1:07	22.0	35.5	56.5	.47	.46	#3 MT @ 24.0
1:14	28.0	52.0	103.	.32	.25	#4 MT @ 30.2
1:21	35.0	89.5	213.	.18	.12	#5 MT @ 38.0
1:32	40.6	162.	439.	.102	.06	
1:44	46.0	567	855	.03	.03	#6 MT @ 46.5
1:53	48.7	Super - Rod @ 38.0				
	48.5	" - Rod @ 40.0				
	48.3	Critical - " @ 42.0				
	48.05	Slightly supe - Rod out.				
	47.85	Sub critical - " "				

Conclusion: Critical at 47.95 on sight glass

Drain back - 8 - 12" cans with #6, #5, #4, #3
4.5 - " " " #2

Sight glass Ht.	47.95
Zero C.	1.00
Bottom C	0.6
Hc	49.55
Vc.	36.1 L ✓
Mc	1.91 Kg
H/X	493

1/11/50

Exp. #370

Cronin
McLendon
Moffitt

12" Aluminum Reactor 1- 7/8" shell of water.
H/X = 500

Time	Soln — Wt.	#1	#2	C/C$_0$	C$_2$/C$_0$	Remarks
22.7	12.0	18, 18	37, 37	~~37.5~~	∠	#1 MT
234½	20.0	37.5	59.5	.48	.63	#2 MT at 15.5
2:45	23.9	54	109	.30	.34	from #9
3.00	26.9	87	176	.21	.21	9 MT at 26.0
3:03	30.0	168	369	.11	.10	from #8
3:12	32.15	363	922	.05	.04	from #7
3.17	34.0	Rod at 30 cm Critical				
3:19	33.75	Rod at 32 - critical				
3:21	33.55	Sub Critical				

Critical at 33.65 ±0.1cm on sight glass.

Drainback:
#8 } as taken out #9
#7 }

33.65 –
1.0
.6
Hc 35.25
Ve 25.7 ℓ. ✓
Mc 1.36 Kg X
H/X 483

74

1/11/50

Exp # 371 It/X u 500.

Cronin
McLaughlin
Morfitt

12" Al Reactor fully water tamped
Source at 10 cm
Instrument as ℄ 369-

Inventory:

	#9	#8	#7	#6	#5	#4	#3	#2	#1
Cmin 12"	8.0	" 8	" 8	8	8	8	8	6	M.T.

Time.	Sec Hgt.	#1	#2	Co/c.	Co/c.	Remarks.
3[45]	11.0	2.5 ✓	4.5 ✓	1.0	10.5	#1 MT from #2
3[50]	16.6	5.0	10.5	.50	.43	#2 MT @ 17.5
4[00]	~~4.0~~ 19.05	10.0	22.	.25	.225	from #3
4[05]	21.0	19.0	45.	.13	.10	
4[15]	22.1	45.	112	.056	.04	
4[25]	23.1	Critical with rod @		20.0		Temper 1 min high
4[35]	22.9	" " "		" 30.0		Temper on
4[45]	22.75	Subcritical				

Conclusion: Critical @ 22.80 ± 0.05 cm on 37[6] glass.

22.80
1.25
.6
Hc 24.65

Vc 18.0 ℓ ✓
Mc 0.95 ℔
H/X 493

1/11/50

Exp # 372

Crews — 12" Al Reactor. Surrounded by 3-7/8" shell + 1-1 3/4" shell. Water filled. No other reflector. H/X = 500
McLendon
Morfitt
Source & Instruments as per #367
For Inventory See #371. Clear Background of ~~15.0~~ 15.0 & 30.0

Time	Soln Hgt.	#1	#2	$C_1/C_{1.0}$ .52	$C_2/C_{2.0}$ .61	Remarks
4 32	23.0	29.5	49.0	~~.085~~	~~.097~~	from #3 M7 @ 25.5
4 40	24.0	33.0	58.0	~~.076~~ .43	~~.078~~ .52	from #4.
4 53	27.0	99.0	206	.15	.145	
5 00	28.0	417	913	.048	.033	
5 04	28.6	Super critical				
~~5~~ 03	28.5	Super critical				
5 04	28.3	Subcritical				

Conclusion: Critical with eight glows @ 28.4 cm.

Inventory

	#9	#8	#7	#6	#5	#4	#3	#2	#1
cm w 12"	9.0	9.0	9.0	9.0	9.0	8.5	8.5	~~8.5~~ 9.0	DV+3

28.4
1.0
.6
30.0

Vc 21.9 ℓ
Mc 1.16 kg
H/X 493

Bragg correction 0.25 cm.

76

1/12/50 EXPERIMENT # 373 H/X ~ 500

12" Al Reactor surrounded by 3 - 7/8" shells + 1 - 1 3/4" shell filled with $UO_2(NO_3)_2$ @ 12% conc.

CRONIN
MORFITT
McLENDON

Source: Scale - 17.5 cm. Source Ht. = 10.0 cm.

Instruments:	Initial Scale	Trip Pts.
3	100	79 x 100
4	5	—
5	~~25~~ x 2	—
6	25	5.9 x 1000
7	—	.72 @ 4"

TIME	Ht.	#1	#2	M⁻¹	M⁻²	REMARKS
1:05	12.9	8.0, 8.5	17.0 15.5	1.0	1.0	#1 MT @ 3.0
1:13	20.0	~~8.25~~	~~15.5~~	—	—	#2 MT @ 14.0
		18.	32.	.44	.50	
1:21	25.0	43.5	106	.184	.151	#3 MT @ 22.0
1:27	26.9	100	263	.081	.061	Stopped #4
1:34	28.5	Super critical	(Rod @ 21 cm)			
1:35	28.3	"	(Rod @ 28 cm)			
1:37	28.1	Subcritical				

Conclusion: Critical with cyl. flood @ 28.2 cm
1.0
.6
Hc 29.8

Drainbox as per #372.

Vc 21,722
Mc 1.15 Kg
H/X 493

Lab. Colorimetric Analysis on this material 0.0534 g U/g sample. Corresponding to H/X = 477

1/12/50 EXPERIMENT #374 H/X = 477

CRONIN
MORFIT
McLENDON

12" Al. REACTOR — 1- 7/8" shell of $UO_2(NO_3)_2$.

Source : 10 cm. from bottom.

Instruments: Same as #373.

TIME	Ht.	#1	#2	α M^{-1}	⊙ M^{-2}	REMARKS
2:41 pm	13.0	(16.5)	(32.0)			#1 & #2 MT
		16.5	31.5			
2:48	22.3	41.0	82.0	.40	.39	#3 MT @ 22.3
2:53	28.0	86.5	220.	.145	.191	
3:00	31.2	193	573	.086	.056	#4 MT @ 30.3
3:20	32.9	SUB CRITICAL				
3:26	33.5	" "				
3:28	34.1	CRITICAL — Roo @ 25.5				
3:30	33.9	" " @ 28.5				
	33.65	Slightly Super Critical				
	33.55	SUB-Critical				

Conclusion: Critical at sight glass = 33.6 cm.

Drainback as per #372.

Sight Glass reads −1 cm when level is zero in 12" cyl.

33.6
1.0
.6
Hc 35.2

Vc 25.7 ℓ ✓
Mc +36 Kg
H/X 493

78

1/13/50 — Exp. #375 — H/X ~ 477

Cronin
McLendow
Morfitt
Henry.

10" Aluminum Cylinder Surrounded on sides by 2½" stainless steel reflector. Water outside stainless on sides, also Top & Bottom. 30 a 35 cm

Source Scale :- 17.5 Source Hgt :- 10.0 cm.

Time	Soln Hgt.	Instrument 3 4 5 6 7 — Starting Scale #100 ×10 ×2 ×2.5 — #1	#2	M_1^{-1}	M_2^{-1}	Trip Scale. 73×100 Bypass 5.8×100 ×10 @ 7.5	Remarks
12:53 pm	12.3	2.0 (2.0)	2.0 / 2.5 / 2.25				#1 NT @ 2.8 cm.
1:10	11.7	Readjustment of Ht due to blow back of sight glass.					
1:19	20.9	3.75	5.5	.53	.41		#2 NT @ 17.5
1:27	26.0	4.75"	9.25"	.42	.24		
1:37	30.1	7.5	15.0	.27	.15		#3 NT @ 30.8
1:45	36.1	30.0	78.0	.067	.029		
1:51	38.1	Super Critical - Roo @ 33.0 cm					
1:54	37.8	Critical - Roo @ 37.0 cm.					
1:58	37.5	Critical - Roo out!					
	37.4	Sub-Critical					

Conclusion: Critical @ sight glass = 37.50 cm. -
.5
.9
Hc 38.9 cm.
Vc - 19.7 ℓ ✓
Mc - 1.04 kg
H/X 493

With water in tank, sight glass reads minus 0.5 cm. @ zero soln level.

SOLN INVENTORY:

CYL's -	#1	#2	#3	#4	#5	#6	#7	#8	#9	
DV.+2	13.0	12.0	12.0	13.0	13.0	13.0	13.0	13.0		- cms in 12" cyl.

1/13/50 EXPERIMENT # 376

CRONIN — 10" Al. - Surrounded by 2½" stainless reflector only.
McLENDON — (1/6 H_2O present)
MOREIT
HENRY-

Source: Scale. 17.5 - 10.0 cm from bottom.

Instruments as per #375-

TIME	HT.	#1	#2	M_1^{-1}	M_2^{-1}	REMARKS
		18.0	37.0			
2:07	37.6	86.0	264.	.21	.14	
2:11	40.7	116.0	356.	.155	.104	#4 NT @ 43.0
2:23	45.0	483.	828	.037	.045	
2:27		104		.17		Rod in!
2:30	46.8	CRITICAL - Roo @ 42.0 cm.				
	46.6	"	" " 45.0 " .			
2:32	46.4	" - ROD out!				
	46.2	SUB. CRITICAL				

Conclusion: Critical @ sight glass = 46.4 cm.

Drainback: & INVENTORY

#1	#2	#3	#4	#5	#6	#7	#8	#9
DV+40	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0

46.4
Zero .3
Bottom .9
Hc 47.6

Vc 24.1 ℓ ✓
Mc 1.28 kg
H/X 483

BONG CORRECTION - 0.2 cm.

1/15/50

EXPERIMENT #377

H/X = 477

10" Al. – FULLY H_2O TAMPED

SOURCE : SCALE 17.5 – 10.0 cm from bottom.
INSTRUMENTS : AS PER #375.

TIME	HT.	#1	#2	M_1^{-1}	M_2^{-1}	REMARKS
		1.5	2.75			
3:10 pm	11.6	(1.5)	(3.0)			#2 MT 17.0
3:20	24.9	5.0	11.0	.30	.27	#3 MT 30.0
3:28	30.1	8.5	25.5	.177	.117	
3:42	34.0	31.5	90.	.048	.033	
3:47	36.3	CRITICAL – ROD @ 30.0				
3:50	36.1	"	" @ 34.0			
3:52	35.9	"	" @ 40.0			
3:53	35.7	Slightly Super – Rod out!				
3:55	35.6	SUB – CRITICAL –				

CONCLUSION : CRITICAL @ SIGHT GLASS = 35.65 cm.

DRAINBACK AS PER #376

sight glass	35.65
zero cr.	.5
bottom cr.	.9
Hc	37.05
V_c	18.8 ℓ
M_c	1.00 Kg
H/X	493

1/16/50 Exp. 378 $\frac{H}{x} = \frac{493}{477}$

Manfuth 15" Al Fully H_2O tamped

Macklin
Cronin

Source: 5cm from bottom 12.5 cm on scale

Instruments	Trip	Start
3	82×100	×100
4	—	×10
5	—	×1
6	5.8×1000	×25
7	3" from tube	—

	1	2	3	4	5	6	7	8	9	
Inventory:	DV	5.8	5.8	5.8	5.8	5.8	5.8	5.8	5.8	in 15" cyl.
	Dry BG	(12.5)	13.0				(35)	35.5		
	Est. Cr. f ≃ 16 cm.									

Time	Sol'n Ht.	#1	#2	M_1^{-1} ⊙	M_2^{-1} ×	Remarks
12:00	6.1	2.25	3.0			#1 MT @ DV.
		(2.0)	4.0 (3.5)	1.0	1.0	
12:40	12.0	4.75	7.75	.42	.45	#2 MT @ 7.7 from #3
1:00	14.0	7.0	13.5	.29	.26	#3 MT at 13.4
1:10	16.0	18	30	.11	.097	from #4
1:20	17.35	156	36	.013	.0097	from #5
1:25	Rod in tamper up	19	41	.11	.097	
1:30	17.80	Critical Rod at 10 cm				
1:35	17.60	Critical Rod at 12 cm				

Critical [redacted] at 17.5 cm ± 0.1 cm

zero cor	.0
Bottom	.4
H_c	17.9

V_c 20.4 ℓ v

M_c 1.08

H/x 493

82
8/16/50

Ex 379

Morfitt
Maclellin
Groves
Henry.

15" Al Reactor Untamped H/X = 477

Instruments + Source same as Ex. 378

background = (12.5) (35)

Time	Sol'n HH	#1	#2	1/M1	1/M2	
1:40	17.9	32.0	43.5	.39	.81	
		32.0	42.5			
1:54	23.9	68.0	127.5	.184	.270	#4 MT at 21.2
2:00	25.0	87.1	185	.144	.189	#5 MT at 25.0
2:14	26.95					#6 #7
		194	4955	.064	.07	
	Body Rod in	80	160	.157	.22	
	Rod	120	255	.104	.137	
2:30	28.15	Sub Critical Rod out				
2:35	28.70	Critical Rod at 19				
2:37	28.55	Critical Rod at 21				
	28.40	Critical Rod at 23				
	28.30	Critical Rod at 28				

Critical at 28.2 ± 0.1 cm by sight glass.

zero cor. −.3
Bottom +.4
Hc 28.3 cm

Vc 32.3 l ✓
Mc 1.71 kg
H/X = 493

1/18/50

Crowell
McLendon
Morfitt

380

Exp

15" Al Reactor Unstaged $H/X \simeq 720 = 733$

Source @ 20.5 cm 13 cm from bottom.
Bank (Conservative Estimate Co. Critically) 41. cm.

Instruments	Start @	Trip @
3	x100	8.4 x 100
4	x10	—
5	x2	—
6	x25	5.4 x 1000
7	—	

Time	Soln Hgt.	#1	#2	X 1/M	⊙ 1/M	Remarks
9 26	4.6	—	—	—	—	4 9 MT
9 38	11.5	13.0, 14.5, (14.0)	29.0, 31.0, (29.5)	1.0	1.0	2 cm from #1, 2, 3, 4, 5
9 52	20.5	23, 24	26.5 26.5	.60	—	2 cm from #6, 7
10 03	28.5	43	74	.33	.40	2 cm from #1, 2, 3, 4
10 15	36.55	90	214	.155	.138 .094	2 cm from #5, 6, 7, 8.
10 23	40.0	148	378	.095	.074	#8 MT from [illegible]
10 34	44.1	—	—	—	—	#2 MT [illegible] #3 MT
10 36	45.05	Super crit @ 30				
10 38	44.70	Super crit @ 40				
10 40	44.5	Critical				
10 41	44.45	Subcritical				

Conclusion: Critical @ 44.5 cm or Soln Hgt.

$$\begin{array}{r} -.3 \\ +.4 \\ \hline \end{array}$$

H_c 44.6 cm

V_c 50.8 ℓ ✓

M_c 1.79 Kg

H/X 733

84

1/17/50

Dilution

from Part III Mass required for 15" untamped cylinder ab H/X = 800 is from 1.8 to 2 Kg. For 12" untamped nothing definite.

To insure maximum probability of 12" being critical 2.4 Kg of X were left in pit storage cylinders. Water added. (2.4 liters per cyl to give H/X = 721 assuming previous H/X = 660 ± 77) This gives maximum volume in pit about 62 liters.

Colorimetric analysis from lab sampled Eq 380 = 0.0555 gm U/gm
This is equivalent to $\frac{H}{X}$ = 741.5

1/18/60

Exp #381

Crowell — 15" Reactor Tamped H/X ≈ 720

McLendon
Morfitt — Instrument same as #380
Source @ 175cm 10 cm from bottom
Critical Est. — 29 cm

Time	Soln Hgt.	#1	#2	X 1/M₁	⊙ 1/M₂	Remarks.
11:29	12.2	2.0 ✓	4.0 35	1.0	1.0	#6 MT
11:43	20.05	5.5	13.0	.364	.288	#7 MT #8 MT
11:52	23.0	10.0	27.5	.20	.14	# 5 MT
12:08	25.65	47.	136	.042	.028	from #3
12:08	26.6	Critical and @ 22.				
12:10	26.4	" " " 25				
12:14	26.2	Subcritical				

Conclusion Critical @ 26.3 cm.

Zero cor.	.0
Bottom	.4
Hc	26.7
Vc	30.4 ℓ ✓
Mc	1.07 Kg
H/X	~~493~~ 733

Inv.	1	2	3	4	5	6'	7"	8"	9
	6	6	6	6	6	6	6	6	6

Borg Correction 3 mm.

(OK) Bottom correction: Sight Glass read +3 mm when solution at Zero. This value was recalled a week after experiment. Value was cleared by comparison with 15" cyl. which ~~was~~ gave some answer. ~~Check when cylinder is remeasured.~~

86

1/19/50

Exp #382

Crowe
McLendon
Morfitt

12" Al Reactor Tamped H/x ~ 720

Source @ 22.5 15 cm from bottom.

Instruments	Starting scale	Trip @
3	X100	52 X100
4	X10	—
5	X2	—
6	X25	5.1 X1000
7	—	

Inventory: 9.5 cm of height per cylinder

Time	Solv Hgt.	#1	#2	⊙ 1/M	× 1/M	Remarks
9 02	16.9	9.0	36.0	1.0	1.0	#1 #2 MT
		10.0	36.0			BG for Mx
9:31		2.0 } 1.75"	3.0			B.G for tamped.
		1.5 }	3.0"			#3 MT @ 22.2
9:40	30.9	6.6"	17.0"	.292	.177	#4 " @ 31.5
9:52	33.0	7.5	24.0	.233	.125	
10:06	37.2	15.0	49.0	.117	.061	#5 off @ 40.1
10:15	41.7	SUB-CRITICAL	ROD OUT!			
	42.8	SUPER- "	ROD @ 38.0			
10:22	42.6	CRITICAL /	" @ 40.0			
	42.3	SLIGHTLY SUPER.	ROD OUT!			
10:27	42.1	CRITICAL - ROD out				
10:30	42.0	SUB-CRITICAL -				

CONCLUSION: CRITICAL @ 42.1 on SIGHT GLASS.

	42.1 cm
Zero Correction	0.5
Bottom Correction	0.6
H_c	43.2 cm
V_c	31.5 L
M_c	1.11 Kg

Borg Correction 32m.

1/19/50

EXP. # 383

CRONIN — 12" Al REACTOR - UNTAMPED $H/X \sim 720$

MORFITT
McLEWOIN

SOURCE @ 22.5 — 15 cm from bottom.

INSTRUMENTS: AS PER #382

TIME	SOLN HT	#1	#2	⊙ $1/M_1$	× $1/M_2$	REMARKS
		9.5	36.0			B.G.
10:45 am	42.3	41.5	137.	.224	.265	#5 MT
		~~38.5~~	~~94~~			
11:00	50.2	49.5	152	.192	.231	#6 MT @ 52.7
11:10	60.0	50.0	139	.190	.259	#7 MT @

Conclusion: System extrapolates to ∞. —

88

2/7/50

Exp 384

Cronin
Fox
Moffitt
Mackler

12" Reactor Unstamped H/x ~80 High Nitrate

Source @ 8 cm from bottom. Zero @ 11 cm

Instrument	Start @	Trip @
3	x10	85x100
4	x100	—
5	x2	—
6	x25	6x1000

Time	Ht.	I	II	1/c.	1/c.	
		12.0	24.0	1.0	1.0	
12:30	9.1	(12.7)	(25.4)	Ave of 6 5-minute counts		3 MT.
12:50	15.0	28.5	49.5	.445	.485	#1 almost MT.
1:03	19.85	48	89	.27	.285	from #3 & #7
1:14	25.1	94	182	.135	.140	from #7 & #9
1:35	29.2	176	351	.072	.072	#1 MT #5 MT
1:40	31.85	328	656	.039	.039	#7 MT.
						9 MT

Out of Soln.

Extrapolated Critical Height = between 34.2 - 34.6 slight glow ht.
(Reasonably good extrapolation possible.)

Sight Gloss	34.4 T
Zero Corr.	0.2
Bottom Corr.	0.6
Hc	35.2 cm T
Vc	25.67 L T 25.7
Mc	6.06 Kg T

H/x = 88.0

2/7/50

Exp 385

Cronin
Fox
Macklin
Morfit

'12" Reactor Tamped H/x ≈ 80 High Nitrate
Source @ 15.0 cm 4 cm from bottom.
Instrument Source as #384

Time	Hgt.	#1	#2	1/c.	1/c.	
	6.1	4.5	3.0 (3.5)	1.0	1.0	#1 M.T.
2 40	5	(4.5)	4.0			
3 05	10.0	7.5	6.5	.60	.54	from #3
3 16	14.0	22.5	31	.20	.135	#3 M.T. @ 10.5
3 30	15.5	Critical with Taper on. Rod @ 10 cm.				from #5
3 32	15.6	"	"	"	Rod @ 15 cm.	
3 35	16.1	"	"	"	Rod Out.	

9
47

Critical at 15.2 ± 0.1 cm.

When sight glass reads minus 2 mm solution is at zero in 12" cyl. No data on Taper tank.

Sight Glass	15.2 cm
Zero Corr.	0.5
Bottom Corr.	0.6
Hc	16.3 cm
Vc	11.89 l 11.9
Mc	2.8 l

H/x = 88.0

90

2/8/50

Cowan
Fox
Menefee

Experiment #386

10" Al Reactor Completely Covered Height No. H/X ~80

Source @ 17cm 6cm from bottom

Instrument	Sens @	Trips @
3	X 10	95 X100
4	X 100	—
5	X 2	—
6	X25	5.6X1000
7	—	2"

	#1	#2
Background for Untamped Case if needed	19, 19	17, 16
Background for Tamped Case	#1 4.050	#2 3.030

Time	Solu Hgt.	#1	#2	C/Co	C/Co	Remarks
10:37	8.8	4.5 av	3.0	1.0	1.0	From #1 X #5
10:45	14.2	6.5	7.0	.69	.43	#1 MT
10:51	18.0	15.0	17.0	.30	.196	#5 MT
11:02	20.0	52.0	71	.087	.042	from #9
11:08	21.2	Critical Tamper down Rod @ 12.0 cm				from #7
11:10	20.8	" " " Rod @ 24.0 cm				
11:12	20.6	Sub [redacted] Critical Rod out				

Conclusion: Critical @ 20.7 cm sight glass.

Zero Corr = +.5 cm

21.2

Bong Corr +.25

21.45

3" section = +.90

Corrected H_c = 22.35 22.4

V_c = 11.32 11.3

M_c 2.68 2.67 ✓

H/X = 88.0

2/8/50

Crew
Fox
Monfitt

Experiment #387

10" Aluminum Reactor Untamped. Hydr Nos. H/x ≈ 80

Source & Instruments as per 387 386.
Background taken as #386

Time	Soln Hgt.	#1	#2	C/C,	C/Ca	Remarks
11:18	20.85	33	36	.575	.465	
11:32	30.0	40	47	.475	.350	#5 M @ 25
11:39	37.6	47	64	.405	.260	#7
11:45	46.2 45.9	55	76	.345	.220	

Out of Soln.

Conclusion: Critical above 80 cm if at all.

Light Glow > 80 cm
H_c > 81 cm
V_c > 41
M_c > 9.68

H/x = 88.0

Borg correction .25 cm

ZERO Correction on 10" cyl = at zero in cyl sight glass reads minus 0.5 cm (−.5 cm)

92 2/8/50

Exp #388

Crowell — 9" Al Reactor Tamped. Hyfe NO_3 = H/x ≃ 80

Fox
Martin
R. Robb (HP observers)

Same & Instruments for #386

Time	Hgt.	#1	#2	C/c.	C/c	Remarks
3 10	12.3	3.0, 3.5 (3.25)	3.0, 2.50 (2.75)	1.0	1.0	#9 MT @ 7 cm
3 32	20.2	7	8	.465	.345	#7 MT @ 18.0
3 40	24.3	19.5	24.5	.167	.112	
3 50	25.5	40.5	59.5	.08	.046	from #5
4 00	26.7	Critical Tamp Down Rod @ 25.0				
4 04	26.5	Subcritical				

Conclusion Critical @ 26.6 cm on sight glass.

Bottom 1.15
Zero Cor. 0.0
H_c 27.7 cm
V_c 11.34 L 11.4
M_c 2.68 Kg 2.69 ✓

H/x = 88.0

	1	3	5	7	9
cm in 9"	12	12	12	12	7 + DV
cm in 15"	4.3	4.3	4.3	4.3	2.5

Sight Glass Reads 0 at zero level in reactor for water reload experiment

= X

2/9/50

Exp #389 A

Crowd
Fox
Morfeld
Robin (obs).

15" Al Reactor Completely Tamped Height NO_3 $\#/x = 80$.
Source @ 13 cm on scale 2 cm from bottom. Cd Bladed
Tamper.

Instrument	Start	Trip
3	x10	96 x100
4	x100	—
5	x 2	—
6	x25	5.4 x1000
7	—	2"

Time	Hgt.	#1	#2	1/#1	1/#2	Remarks
1:49	4.1	3.75, 4.25 (4.0)	2.0, 2.0 (2.0)	1.0	1.0	#9 HT, from #5
1:57	7.0	5.0	3.5	.80	.57	#5 HT. from #5
2:09	9.1	8.0	6.0	.50	.33	5HT
2:24	10.5	12.0	11.5	.33	.175	
2:29	11.5	25.0	26.0	.16	.078	from #3
2:40	12.0	68.0	68.0	.059	.030	
2:45	12.4	Subcritical				
2:48	12.5	Critical Rod @ 13 cm.				

#389 B

Top Tamper up. Using Pneum Cyl.

2:52	12.5	11.0	10.0	.365	.20	from #3
2:54	13.2	15.0	13.0	.27	.155	
3:05	14.2	26.0	26.0	.155	.078	
3:12	14.9	59.0	66.0	.068	.030	
3:18	16.3	Subcritical				
3:22	15.5	Critical Rod @ 14 cm.				

	389A	#389 B
Scale Calc	12.45 cm	15.4 cm
Bottom Corr.	+0.4	+0.4
Zero Corr.	−0.2	−0.2
H_c	12.7 cm.	15.6 cm
V_c	14.47 1.45 ✓	17.78 17.8
M_c	3.42	4.19 4.20 ✓

#/x = 88.0

94 2/9/50

Exp. #390

Crown
Fuf
Maffett
R Rohr
(HP 16.)

15" Al Reactor Unstamped H_2O_2 $H/x \simeq 80$
16 cm scale 10 cm from bottom.
Source @ ~~10 cm~~ ~~24~~ cm scale.
Instruments as for #389-A

Time	Soln Hgt	#1	#2	× 1/m.	⊙ 1/m	Remarks
3:37	15.7	30, 36 (34)	32, (32)	1.0	1.0	#3, 5, 7, 9 MT
3:44	17.0	42	44	.81	.73	from #1
3:48	18.0	52	57	.65	.56	
3:53	19.1	68	79	.50	.405	
3.59	19.9	82	99	.415	.325	
4:02	20.8	120	148	.285	.215	

Soln of Soln.

Extrapolated #1 Counter 22.7
#2 Counter 22.6

Conclusion Critical @ 22.6 ± 3 mm.
Bag correction 0.2 cm

Soln in
Sight Glass Reads +4 mm when cylinder @ 3 cm +
top or tank empty

Sight glass	22.6 †
Zero corr.	−0.4
Bottom corr.	+0.4
H_c	22.6 † cm
V_c	25.8 † L
M_c	6.09 † Kg U

$H/x = 88.0$

† Extrapolated

Tube Data

Volume occupied by closed end Aluminium Tubes (106 tubes)

O.D. = 1" = 2.54 cm

Take height as 1 cm this volume of 106 Tubes per cm of height

$(0.7854)(2.54)^2(1) \times 106 = 5.066 \times 106 = 537.0$ cc/cm

— o —

Volume inside closed Tubes per cm length.

ID" = 15/16" = 2.38 cm

Take height as 1 cm, the volume of 106 tubes per cm of height

$(0.7854)(2.38)^2(1) \times 106 = 4.45 \times 106 = 471.7$ cc/cm.

— o —

Volume displaced by open end tubes per cm. length.

537.0 − 471.7 = 65.3 cc/cm. for 106 tubes

or 0.616 cc/cm per tube.

1140
65-
1075

— o —

Volume displaced by rods per cm height

$(0.7854)(0.375)^2(1)(6.45) = .712 \times 3 = 2.14$ cc/cm for 3 rods

— o —

65.3
67.4 Total area & Void using open tubes

Volume Bottom Plate =

$V_A - [V_B + V_C + V_D + V_E] = 1765 - [702] = 1063 \text{ cm}^3$

$V_A \equiv$ Volume Solid Plate

$V_A = \frac{\pi D^2 H}{4} = 0.7854 \times (14.8125)^2 \times 0.625 \times 16.39 = 1765 \text{ cm}^3$

$V_B =$ Volume center Hole

$V_B = 0.7854 \times (1.5625)^2 \times 0.625 \times 16.39 = 19.6$

$V_C =$ Volume 108 1 3/8" holes

$V_C = 0.7854 \times (1.125)^2 \times .375 \times 16.39 \times 108 = 6.11 \times 108 = 659.9$

$V_D =$ Volume 108 1/4" holes

$V_D = 0.7854 \times (.25)^2 \times (.25) \times 16.39 \times 108 = .196 \times 108 = 21.1$

$V_E =$ Volumes 6 5/16" holes

$V_E = 0.7854 \times (.3125)^2 \times (.25) \times 16.39 \times 6 = .314 \times 6 = 1.8$

Volume of Leveling Screws 3.6 cc.

Volume Plate + Screws $\frac{1067}{1140}$ cm^3 = .936 cm lbs.

8/14/50

Exp. #39

C. Crowe, Fox, Hurwitt, Krewson, Rohn.

15" Al Reactor Tamped Containing tube bundle

106 (open-end) tubes spaced as per period # LDP-D 814, 15, 16.

Purpose of experiment: to evaluate effect of voids produced by aluminum before running B_i - core experiment.

No tube in normal position of source, safety rod or control rod.

$Hi\ IO_3$ $H/X \simeq 80$

Time	Soln Hgt.	#1	#2	+ 1/M	⊙ 1/M	Remarks
2:57	9.2	5.0, 4.5	4.5	1.0	1.0	#2 ∠ H.T.
3:04	14.0	7.5	7.5	.60	.60	#5 HT @ 13.0
3:12	16.0	15.5	18.0	.29	.25	
3:20	16.8	24.5	26	.185	.175	
3:24	17.3	45.0	47.5	.100	.095	Stop #3
3:32	17.6	68.0	73.5	.067	.061	From #1
3:40	17.9	162	113	.027	.025	
3:42	18.2	Control Rod @ 9 cm.				
3:45	18.1	" " @ 15 cm				
3:47	18.0	Saturated				

Conclusion Critical @ 18.05 cm in sight glass.

5.06 area
1.06 water
30 36
5.06
536. cm²
28
538
for closed tube
1140 cm²
538
602 cm² net area

rods.

Inside Cross-sectional area of one tube 4.45 cm² } dif. .61
outside " " " " " 5.06 cm² }

		cut height	18.05	
15" area	1140 cm²	zero corr	−.20	
Void area	67	But. "	+.40	
net area	1073	Bot. Plate	−.95	
			Hc 17.3	
			Vc = 18.56	
			Mc = 4.39	
			H/X = 88.0	

	Instrument	3	4	5	6	7
Start @		[redacted] X100	20	X2	25	
Trip @		85 X100			5.5 X1000	5.5

96
2/15/50

Exp # 392

Crowin
Fox
Krewin
Morgan
Roth

15" Aluminum Reactor Tamped Contains tube bundle

#106 ~~Set~~ Al tubes Closed at lower end. Spaced as per drawn LDP-D 814, 5, 6.

Purpose of experiment To determine effect on homogeneously spaced ~~voids~~ throughout the 15" cylinder, for comparison with units in Bi rods in some space.

Instrument	Start @	Trips @
3	~~0~~ x100	95 x100
4	10	—
5	1	—
6	25	6 x1000
7	—	2° (SR)

Source at @ 16.5 cm 0 at 9.5 cm.

Time	Soln	#1	#2	1/M1	1/M2	Remarks
3:13	9.3	~~4.5~~ 5.0 4.5 (4.75)	3.6 4.0 (3.75)	1.0	1.0	#9 AT from D7 #9 AT @ 13.2
3:30	16.0	5.0	3.0	.95	—	#5 AT @ 20
3:35	19.9	6.0, 5.0	3.5, 4.0	—	—	
3:44	23.6	5.0	4.5	.90	.83	
3:50	27.4	6.5	5.0	.73	.75	#3 AT @ 30.5
4:00	35.5	8.0	7.5	.59	.50	
4:05	38.8	10.0	9.0	.475	.42	

Out of solution. Straight line extrapolation ≈ 55

Conclusion: Critical only above 45 cm if at all.
(But Estimate of criticality 54 cm)

Inventory:	#1	#3	#5	#7	#9
cm in "shallow" cyl.	9.0 cm	9.0 cm	9.0	11.0	1.0 cm + DV

Crit height > 55
H_c > 54
V_c > 32.6
M_c > 7.69 7.70 V

H/x = 88.0

2/16/50

393

Ex ~~393~~

N/t ~7½

Callihan
Moffitt
Kruesi
Fox
Rohr
Gonin

15" Al Reactor Tamped

contains 1060 Al tubes closed at lower ends and filled with 250 cc of water approx 60 cm lth. Spaced as per drawing LDP-D 814-15-16

Instruments	Start	Trip
3	×100	96 ×100
4	×10	—
5	×1	—
6	×25	5.5 ×1000
7	—	3 inches

Source zero at 9.5 cm on scale set at 16.5 cm on scale.
#1 counter moved to ~~12"~~ from Tamper tank to front of shield (in line with source)

Time	Sol'n	#1	#2	1/m.	1/m²	Remarks.
10:15	10.1	7.5 } 7.75 8.0 }	4.0 } 5 6.0 }			#7 in Tab 11.5 cm
10:30	[redacted] 15.0	14.5	9.0	.53	.55	Stopped #5 at 15.6
10:40	17.1	37.5	29.0	.205	.172	
10:45	17.8	~~500~~ 74.	57.	.105	.087	
11:00	18.3	333	283.0	.023	.018	#3
	(Control Rod at 18.5)	259	216.0	.03	.023	
	(Control Rod in)	97	74.5	.08	.067	
11:15	18.5					

Critical at 18.4 cm ± 0.1 cm

Zero cor	-.2	
Bottom "	+.4	
Plate	-.95	
Hc	~~17.65~~	17.65
Vc	~~10.62~~	10.62
Mc	~~2.51~~	1.99 Check

H/X = 88.0 ? (Solid UNH on fid cylinder walls ?)
2 11.5

~~Ex 394~~

~~Inventory in 15" Al cyl (with rod tube)~~

~~#1~~	~~#3~~	~~#5~~	~~#7~~	~~#9~~
~~9.0 cm~~	~~9.0 cm~~	~~9.0~~		

2/17/50

Experiment #394

Cronin — 15" Al Reactor Water Reflector Tank only + 106 tubes

For Morfitt — no rock LDP-D-814.5.6 filled to depth of 27 cm with metallic Remarks

Instrument	Start @	Trips @
3	X100	95
4	X10	—
5	X1	—
6	X25	5.5 X 1000
7	—	88

Source set @ 13 cm. (Zero at 6 cm on scale)

Time	Soln Hgt	#1	#2	1/M.	1/M	Remarks
9:25	10.8	14.5, 15.0 (14.5)	4.0, 3.5 (3.75)			#4 & 7 MT @ 11.0
9:35	17.2	21.5	5.0	.673	.75	5 MT @ 20.4
9:42	24.3	30.5	8.5	.475	.442	
10:00	28.0	38.0	11.5	.382	.326	
10:07	30.1	~~14.5~~ 41.5	14.0	.335	.268	

Tube covered at this point
Experiment Stopped.

Conclusion: Critical @ >40 cm.
(Best estimate of criticality: 44 cm.)

Inventory:	#1	#3	#5	#7	#9
one in "hollow tube" 15" cm.	2.0	2.0	2.0	2.0	2.0 cm + D.V.

$H_c \sim 44$

$V_c \sim 26.4$

$M_c \sim$ ~~4.97~~ 4.95

$M/f = 7.48$

$H/X = 88.0$? (Solid UNH on pitch gel walls?)

$= 30.2$ 115

2-21-50 Pit fitted with alkyls & leak tested

Dilution order is # 1 2 3 4 5 6 7 8 9
J A C E F G H D B

Aimed at H/X = 240

removed contents of cyl #9 (H/X 76 DFC ~ 4.7 +1? l.) in cyl M now stored in pit.

Redistilled 11.6 cm (15 lbs F. in F tubes in lab) (calc 2.77 liters) in each of #1 thru 7
Σ all soln in pit gave SG reading 32.8

Residue (DV + 0.2 cm ~ 0.6 SG - 0.4 gm corr) had 5.34 l with added pit & mixed. This mixture now drained jointly into 8 & 9.

Quit for day at this point. Plan to add 4.11 liters water to each of #1 thru 7 and mix in pit cylinder tomorrow.

Pike
Jolly

2-22-50 J Fox recalculated H/X getting 88 rather than the 76 previously found by DFC. ∴ halted dilution

2-23-50 JWM & RLM also recalculated H/X also & got 88.0 after a few false starts. Formula appended.

for solutions containing only H_2O, HNO_3, $UO_2(NO_3)_2$

let A = gm U / gm Soln B = moles N / moles U C = gm x / gm U

molecular wt of U taken as 235
H " " 1
N " " 14
O " " 16
[P " " 31]

$$H/X = \frac{H_1 + H_2}{x} = \frac{2(\text{moles } H_2O) + 1(\text{moles } HNO_3)}{C(\text{moles } U)}$$

$$\frac{\text{moles } HNO_3}{\text{moles } U} = B - 2 \qquad \frac{\text{moles } H_2O}{\text{moles } U} = n$$

where n can be found simply by solving

$$\frac{\text{gm soln}}{\text{gm U}} = \frac{1}{A} = \frac{391 + 63(B-2) + 18n}{235}$$

whence $n = \frac{\frac{235}{A} - 63(B-2) - 391}{18}$

$= \frac{1}{C}\left[\frac{235}{9A} - \frac{54}{9}(B-2) - \frac{391}{9}\right]$

and $H/X = \dfrac{\frac{235}{9A} - \frac{63}{9}(B-2) \mp \frac{391}{9} + (B-2)}{C}$ ← round about 1 pt. each correction for H at HNO_3

or $\boxed{H/X = \frac{1}{C}\left[\frac{26.11}{A} - 6B - 31.44\right]}$ for H_2O, HNO_3, $UO_2(NO_3)_2$ only

C = assay $\left(\frac{gm\ X}{gm\ U}\right)$

A = concentration $\left(\frac{gm\ U}{gm\ solution}\right)$

B = N/U ratio $\left(\frac{moles\ N}{moles\ U}\right)$

Values used here $C = .933$ $A = .1680$ (from weighted average of analyses) (not pond experimental analyses tho.)

$B = 6.98$ (not ~~final~~ value)

$H/X = \frac{1}{.933}\left[\frac{26.11}{.1680} - 6(6.98) - 31.44\right] = \frac{1}{.933}\left[155.42 - 41.88 - 31.44\right] = \frac{82.10}{.933} = 88.0$

dilution formula as always

cc of water to add per cc of old solution is

$$\boxed{(\text{new } H/X - \text{old } H/X)\left(\frac{9}{235}\right)(\text{old density})\left(\text{old concentration in } \frac{gm\ X}{gm\ soln}\right)}$$

holds for any solution when only water is to be added to raise the H/X value.

→ Note: In order to reduce confusion resulting from "scrap-paper" calculations made in the past let us agree that:

1. The H/X corresponding to a given laboratory analysis will be calculated from formulas at top of this page. (or formula on next pg if phosphate present)
2. The calculation will be made by calculating machine of the result entered in this book (or subsequent books) at the place in the book where dilution or receipt of solution was made.
3. Dilutions will likewise be recorded; sufficient space in book will be left (after dilution data are recorded) to record laboratory analysis, requisition number, & H/X.

4. H/x's for dilution may be made at any time. The official H/x will be calculated from a sample especially submitted for that purpose.

5. The official H/x calculated as above will be recorded along with the official Hc, Vc & Mc at bottom of each data sheet

JWM 2/23/50.

— o —

Further dilution calculations:

To go to 240 H/x from 88

$$(240-88)\left(\frac{9}{235}\right)(1.505)(.1568) = 1.373 \quad \frac{\text{cc water to be added}}{\text{cc present solution}}$$

now Cyls #1-6 contain 4.6 cm at 0.604 l/cm or 2.77 liters each #7 is 1 liter less because of bottom plate or 1.77 and 3.6 liters (DV + 2mm) mixed with 5.34 liters of water is in 8 & 9.

∴ Total solution of H/x = 88 was 23.0 liters To which (23.0)(1.373) = 31.58 l of water should be added. As 5.34 liters are in 8&9 already 26.24 liters should go into 1-7. Cylinders 1-6 require $\frac{26.24}{6.64} = 3.95$ liters H_2O each

and #7 $(3.95)\left(\frac{1.77}{2.77}\right) = 2.53$ liters H_2O

An H/x computation formula for $UO_2(NO_3)_2 + HNO_3 + H_3PO_4 + H_2O$ has been derived:

let A = gms U / gms solution
B = moles N / moles U
C = gms X / gms U
D = moles P / moles U

molecular weights used	
U	235
O	16
N	14
P	31
H	1

$$H/X = \frac{1}{C}\left[\frac{26.11}{A} - 6B - 7.89D - 31.44\right]$$

1.0718

Phosphate
Nitrate
Water
Uranyl nitrate

This can be readily derived as before
let n = moles H / moles U whence H/x = n/C

62
80
142
71

Considering the acids as anhydrides take

	MW		moles		weight
$\frac{1}{2}(P_2O_5)$	71	×	D	=	71D
$\frac{1}{2}(N_2O_5)$	54	×	B-2	=	54(B-2)
$UO_2(NO_3)_2$	391	×	1	=	391
$\frac{1}{2}(H_2O)$	9	×	n	=	9n

$H_2O + N_2O_5 \rightarrow 2HNO_3$

$3H_2O + P_2O_5 \rightarrow 2H_3PO_4$

$$\frac{\text{grams Solution}}{1 \text{ mole } U} = \frac{235}{A} = 71D + 54(B-2) + 391 + 9n$$

-31.444

$$\text{whence } H/X = n/C = \frac{1}{C}\left[\frac{235}{9A} - \left(\frac{71}{9}\right)D - \left(\frac{54}{9}\right)B + \left(\frac{54}{9}\right)(2) - \frac{391}{9}\right]$$

1.0718

New Dilution ~ H/X ~ 240

2/24/50

H/X ~ 260
H. NO_3

Experiment #395

Morfitt
Fox
Macklin
Henry

15" Al Reactor Water Reflector sides only + 106 Tubes in core LDP-D-814.5.6 filled to depth 27 cm with Bismuth metal.

Source Zero at +1.5 cm.
Source Set. @ 11.5 10 cm from bottom

Starting Inventory:

Cyl. #	1	2	3	4	5	6	7	8	9
cm in Tube filled 15" reactor	10.0	10.0	10.0	10.0	10.0	10.0	10.0	6.0	

Instruments	Start	Trip
3	X10	98 X 100
4	X20	—
5	X5	—
6	X25	5.8 X 1000
7	—	2" from source.

Time	Sol. Ht.	#1		#2		$1/M_1$	$1/M_2$	Remarks
1:00	12.6	9.5 9.0 9.0	9.2	4.5 5.5 5.0	5.0	1.00	1.00	
1:15	19.8	11.0		6.5		.84	.77	fill from #1
1:20	26.2	15.0		8.0		.61	.62	
1:25	30.0	18.5		12.0		.50	.42	fill from #2 at 29.2
1:30								Max. ht. of Tsi. at 30.0
1.30	38.0	28.0		22.0		.33	.23	

Drainback: #1 10.5 cm in 15 in. with tubes (604 cm²)
2
3
4
5
6
7
8
9 DV. + 4.0 cm

H_c ~ 45
V_c ~ 27.0
M_c ~ ~~2.76~~ 2.75 ✓

$H/X = 230$

Conclusion: Critical above 40 cm.
Best estimate criticality 45 cm

106
3/22/52

H/V = 240
H.NB

Experiment #396

For Macklin Mofatt

15" Aluminum Reactor Water Reflected Scale only

+106 open-end tubes in rack LDR 2814 #5, 6.

Source zero 1.5 cm. Set @ 12 on scale.

Instrument	Stat	Trip
3	X 20	92 X 100
4	x 50	—
5	x 2	—
6	x 25	5.8 X 1000
7	—	1½" ~.8

Time	Soln Hgt.	#1	#2	1/M1	1/M2	
9 35	13.0	7.0 6.0	6.5 7.0	1.0	1.0	#9 MT @ 2.3
9 46	16.7	24	25.5	.27	.265	#8 MT @ 8.3
9 48	17.5	51.5	61.0	.126	.106	#7 MT @ 14.
Rod in		36.	40	.18	.17	#6 MT @ 17. from #1

Rod worth 3-4 mm. Expected critical 18.0

10.04	18.1	Leaked base into #1 cylinder cleaned room (OK)				
10:14	← 17.95 after leak	133	164	.049	.041	
	18.35					

Conclusion: Critical on sight gloss @ 18.15

Zero Con.	-.20
Bot "	+.40
Plate	-.95
Hc	17.40
Vc	18.47
Mc	1.90 ✓

H/X = .230

7-27-50

H/X = 200
H. NO3

Exp # 397

For Harry Medlin Hoffman Robb

15" Aluminum Reactor. Water Reflector Sides only.

+ 106 closed end tubes in rack LDP-D 814, 5, 6.

Source exp @ 1.5 Set @ 17 cm.

Same & Instrument same as #396

Time	Ion Hyp	#1	#2	X 1/M.	⊙ 1/M.	Remarks
1:26	17.8	11.0 ~~6.0~~	6.0	1.0	1.0	9 MT @ 4.0
1:31	25.6	14.0	6.5	.79	~~.80~~ .82	8 MT @ 14.0
1:40	32.0	18.0	9.0	.61	.67	7 MT 21.0
1:48	39.9	23.0	14.0	.48	.43	6 MT 29.0
2:00	50.1	32.5	22.0	.34	.27	1 MT 39.9
		33.0	22.0	—	—	2 MT 48.0
2:18	57.8	48.5	36.0	.23	.17	3 MT 57.6
2:40	69.5	77.0	61.5	.14	.09	4 MT

Critical @ >80 cm if at all.

Best estimate of criticality 85 cm.

Inventory	1	2	3	4	5	6	7	8	9
Cm in 15", 106 rods	9.5	10.0	10.0	10.0	10.5				

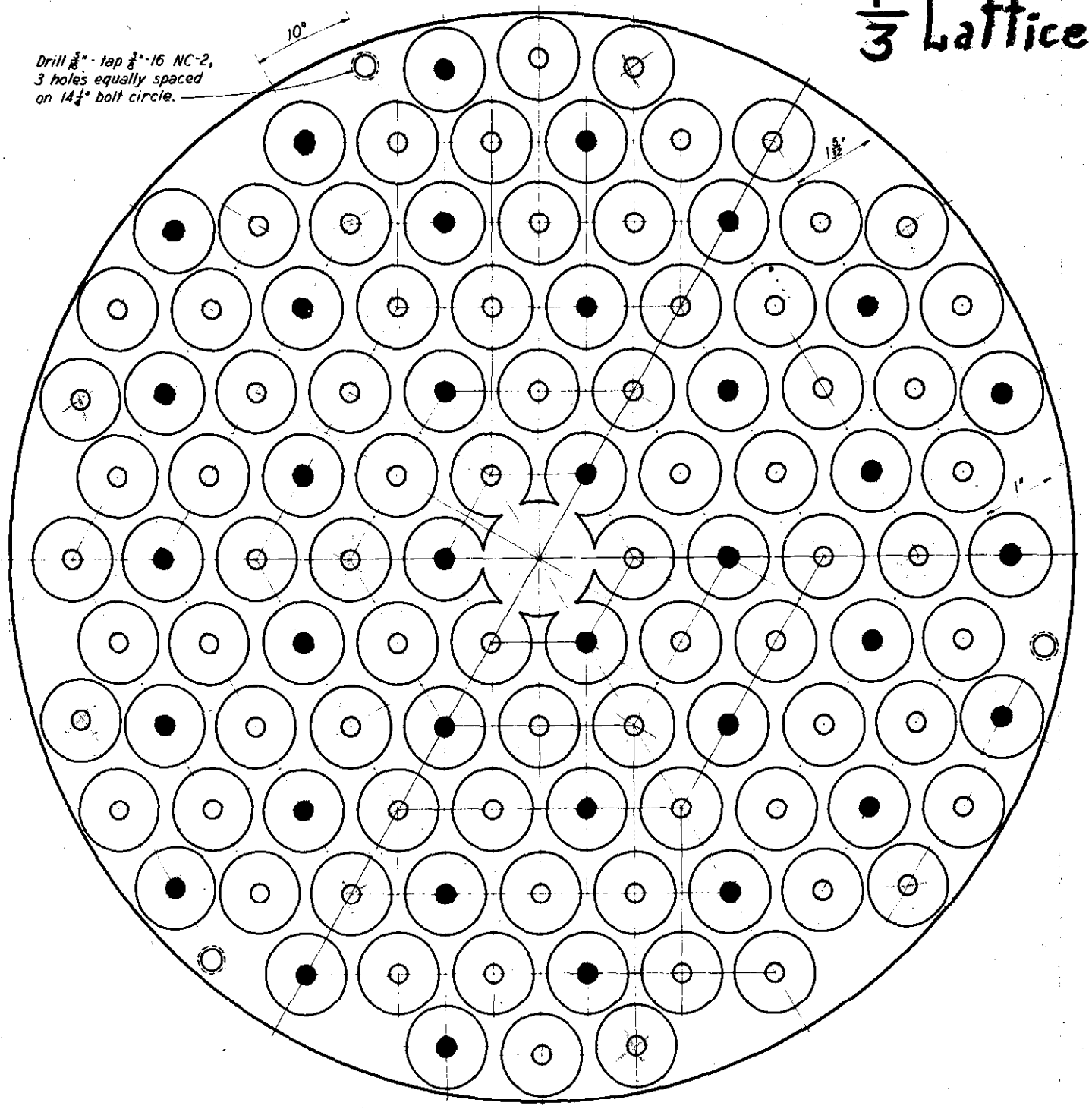
$H_c \sim 85$

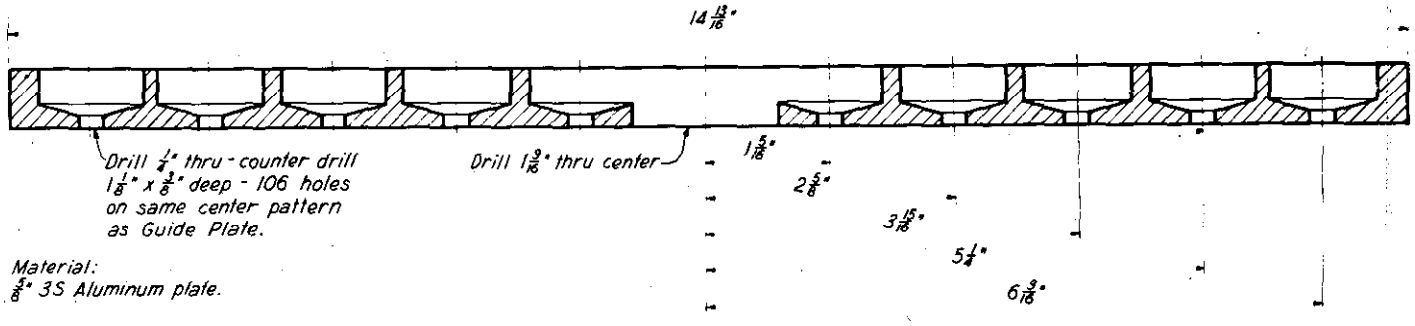
$V_c \sim 51.2$

$M_c \sim 5.2$

$H/X = 230$

1/3 Lattice





Material:
3/8" 3S Aluminum plate.

CM TUBE RACK
- BOTTOM PLATE -

Allen	JWM
LDP-D-816	

2-2-50

4/28/50

H/X ≈ 240
4. NO_3

Exp. #398

For Macklin Morfitt Rohr.

15" Al Reactor Tamped Lucite adj, Containing 36 rods as per print p 108. H/X ≈ 240.
Source @ 11.5 cm.

Instrument	Start @	Trip @
3	X 10	92 x 100
4	X 20	● ——
5	X 2	——
6	X 25.	5.8 x 100
7	——	— 2" (Bypass)

Time	H.	#1 (11.25)	#2 (7.25)	X 1/M.	⊙ 1/M	Remarks
9:22	12.5	11.0, 11.5	7.5, 7.0	1.0	1.0	#9, 8 AT.
9:36.	17.25	17.5	11.5	.64	.63	#7 @ 15 cm.
9:41	22.5	193	137	.058	.053	
	Blade ∞	92.5	——	.121	——	Stepped from #6
9:55	23.2	Critical with rod @ at 20.				
	~~23.~~ 23.1	Critical " " @ 30				
9:59	23.0	Subcritical with rod out.				

Conclusion: critical @ 23.05 cm ow sight glass.

36 x 5.04 = 182
+ rods 2
184

1190
184
956 cm²

Zero cor.	-.20
Bot cor.	+.40
Plate	-.95
Hc	22,30
Vc	21.3 ℓ ✓
Mc	2,17 ✓

$H/X = 230$

7/12/5°

Experiment #399

H/X ~240 U.NO

For Manhattan Project Rohm

15" Al Reactor Tanped. ~~Ben~~ Side only +36 tubes filled with 250 cc. H_2O tubes spaced as per #108.
Source @ .6cm from bottom. Instruments same as exp #398.

Time	Soln Hgt	#1	#2	X 1/M.	⊙ 1/M	Remarks
11:10	7.8	8.5 ✓	4.5 ✓	1.0	1.0	#9 & #7 MT @ 10
11:20	#12.0	13.0	7.0	.65	.65	
11:33	16.0	31.5	20.5	.27	.22	
	Rod in	29	—	.29	—	
11:37	17.1	56	37	.15	.121	
11:47	18.0	204	147	.042	.030	
	Rod in	120	—	.071	—	0.2 min.
	18.3+	Saturated with rod out.				
11:50	18.5−	Red @ 20 cm.				

Conclusion: Critical with safety plate @ 18.40 cm
Total Hc. −.75
Hc = 17.65
Vc = 16.8 ± 90 ℓ
Mc = 1.72 kg. U ✓

H/X = 230

2/28/50

Experiment #400 - H/X ≈ 240 H.100₃

Maccabia
Fay
Mayfield
Rohr

15" H1 Reactor Tamped Sides only + 106 tubes filled with 250 cc H₂O. See layout on p 108
Source rod 8 cm as scale

Time	Sola Hgt.	#1	#2	X 1/H.	⊙ 1/H₂	Remarks
2:44 - 2:55	~~0~~ 10.2	7.5 ✓ (28)	3.0 ✓	1.0	1.0	A9 H8.47
3:00	~~0~~ 17.0	15 (19)	7.0	.50	.43	H7H1 @ 14
3:06	19.5	22.5 (16)	11.0	.33	.27	from #6
3:18	22.0	47.5 (28)	27.0	.158	.111	S/S layout #6
3:27	23.8	188 (52)	125.0	.040	.024	
	Rod in	95	—	.079	—	
3:38	24.4	Critical Rod @ 20.0				
3:42	24.3	Subcritical with rod out.				
3:44		237 (27)				

Conclusion: Critical with safety glass @ 24.35
Told Correction -.75
Hc 23.40
Vc 19.2 ~~+ l~~
Mc ~~+.45~~ 1.44 ✓

H/X = 230

112 3/2/50

For Moffitt Rohrer

Exp #401 $HiNO_3$ H/x ~240

15" Al Reactor Water Tamped Tube only + 36 tubes filled with Bi spacers as per page 108

Source @ 10 cm on scale 8 1/2 cm from bottom.

Instrument	Set @	Trip @
3	x10	78 x 100
4	x10	—
5	x1	—
6	x25	6 x 1000
7	—	0.76

#9 MT @ 48.

Time	Soln Hgt.	#1	#2	X 1/4.	⊙ 1/4	Remarks
9:52	10.4 10.6	10.0	4.0	1.0	1.0	#9 MT @ 48
		9.15 ✓	3.0 (3.5)			
10:25	15.2	15.0	7.0	.63	.50	#9 MT
/	15.4, 15.6, 15.8 on Glowback		15.7			#7 MT
10:42	18.5	36.0	17.0	.265	.205	
10:50	20.0	100.5	53.0	.095	.066	
	~~20.4~~	60	—	.16		
	20.8	Subcritical ~~from~~ ends rod out.				
11:10	21.0 Critical. 17 cm up from bottom					

Conclusion out at 20.95

Total correction -.75

H/L = 20.20

V_c = 19.3# ✓

M_c = 1.96 ✓

H/x = 230

3/24/50
For Moeslin Morfitt Roher Rohrer

$H:NO_3$
$H/X \sim 240$

Experiment #402A

15" Al Reactor Completely Water Tamped $H:NO_3$ $H/X \sim 240$

Instruments as per #401

Source 6 cm from bottom.

Baffle for Tamped 6.75, 3.5 tamper up, tamper down 8.0 2.5
" " untamped 16.5, 17.5 9.5 8.5 ×

Time	Soln Ht.	#1	#2	1/M.	1/M	Remarks
1:54	8.0	6.5, 7.0	3.5, 3.5	1.0	1.0	9MT @ 1.0
2:02	11.1	20.5	8.0	.34	.44	8MT @ 7.0
2:12	12.0	38.5	17.0	.175	.205	7MT @ 12.0
2:20	12.6	81.5	42.5	.084	.082	6 reading -
	Rod in Tamper up	35.				
2:27	13.2	Critical Tamper down Rod @ 10 cm.				
	13.0	Critical " " Rod out				
	12.9	Sub " " " "				

402B

Top Tamper Lead @ 63 cm.

2:48	12.9	13.5	10.0	.50	.35
2:55	14.0	25.0	15.0	.27	.23

Comparing results here with that of exp 389A+B gave need of considering possibility of height of water in tamper tank effecting critical height of system with top tamper up. According drained tank to 12.9, added water to fill tamper tank ×

3:04	14.0	23.5	12.0	~ .27	~ .23
3:07	15.0	67.0	32.0	.10	.095
3:10	Rod in	40		.17	
3:12	15.5	Critical with rod out.			
3:13	15.4	Subcritical			

402-A

crit. Ht. 13.0
correction +.2

Hc = 13.2
Vc = 15.05
Mc 1.53

Repeat of Ring correction 2.5 mm. 2.0 mm

402-B

crit Ht 15.5
cor. +.2

Hc = 15.7
Vc = 17.90
Mc = 1.82

114 3/2/50

Fox
Macklin
Moffitt
Rohr
Rohrer

H/X ≈ 240
Hi UO_2

Experiment #403

15° Reactor Unstaggered. [redacted]

Scrams & instruments as per #401
Berg. 17.0, 9.0

Time	Soln Hgt	#1	#2	X 1/M	⊙ 1/M	Remarks
3:15	15.7	51	28	.333	.32	
3:22	17.9	86.5	56	.195	.16	#CM: @ 18.7
3:30	20.0	149.0	112	.115	.08	from #5
	22.0	527.5	442	.022	.020	
3:42	Rod in		315	.055		
3:47	22.65	Subcritical Rod out,				
3:48	22.8	Critical, Rod @ 15 cm. (closer to critical than as run)				

Conclusion: Critical with sight glass @ 22.7 cm.
Total corrections .0

H_c = 22,7 .9
V_c = 25 [redacted] ℓ
M_c = 26 3 kg U

H/X = 230

3/3/50

Experiment #404

H.F. ~240
H: NO_3

For 12" Reactor Tamped.

Manlin
Morfitt
Rohrer

Source set at 6 cm from bottom.

Instruments	Tube	Tape @
3		87 X 100
4		
5	X1	
6	X25	6 X 1000
7		2"

Bergad tamped 5.5, 5.0 #1 2.0, 2.0 #2
" untamped 21.0, 22.5 17.0, 17.5

Time	Set HF.	#1	#2	× 1/4	⊙ 1/10	
10:40	8.0	5.25	2.0	1.0	1.0	9 MT, 7 MT @ 9.5 cm from 6
11:08	12.5	10.5	5.5	.50	.36	
11:15	14.5	30.0	18.0	.175	.111	
11:24	15.0	51.0	29.0	.103	.069	stopped 6 from 3
11:32	15.8	Supercritical rod @ 12 cm Taper down.				
11:35	15.65	"	"	" 20 cm Taper down.		
	15.50	Barely subcritical				

Conclusion Critical @ 15.5 cm on Stgd Rod

zero cor.	+.7
Bot. cor	+.6
Hc =	16.8
Vc =	12.13 l.
Mc =	1.25 kg U

H/2 = 230

116 3/3/50

H/x ~ 240
H. NO3

Exp #405

Fuf
Maxlin
Martin
Rohrer

12" Reactor Unloaded

Source + Instrument Same as #404

Time	Bkgnd. Hf.	#1 #1	22 " #2 17" #2	X 1/M1	⊙ 1/M2	
1:04	15.4	~~34.~~ 38.	24.5	.58	.70	#6 MT @ 20.0
1:12	20.2	67.5	51.5	.30	.33	
1:19	22.9	91.5 90.0	77.0	.24	.22	from #5
1:40	27.4	183.5	163.0	.12	.104	#5 MT @ 28
1:48	29.8	389.5	377.0	.056	.045	
	Rod in	230.0	—	.074	—	
1:53	31.2	Too high & counts.				
2:01	31.95	Critical Rod @ 26 cm.				
2:04	31.70	Subcritical Rod out. (Barely)				

Conclusion Critical at 31.75 cm on Sight glass.

		1	2	3	4	5	6	7	8	9
cm in	12" gap	~9	~9	~9	~9	~~9.2~~	9.1	9.2	8.0	DV+2.0
π×730 cm²	liters	6.55	6.55	6.55	6.55	6.70	6.63	6.70	5.82	4.96

{Soup at zero - tamper water drained
SG reading — 0.5 cm.

Sight Glass c. 31.75
Zero cor +.5
Bot. " +.6
Hc = 32.85
Vc = ~~23.9~~ 29.0 l.
Mc = 2.44 kg. ✓

H/x = 230

3/6/50

H/X ~ 200
Hi NO_3

Exp # 406

Henry
Mihalasky
Merritt
Roka
Rohrer

10" Reactor Tamped

Source @ 8 cm from bottom. Zero @ 1.5

Instrument	Start	Trip
3	X10	90 x 100
4	X10	———
5	X1	———
6	~~———~~ out	———
7	←	1¾" .72

				X	⊙
	Beyond	Untamped	21.0	16.0, 15.5	
		Tamped.	4.0	2.0, 1.0 1.0	

Time	Sec	#1	#2	1/#1	1/#2	
~~———~~ 10:40	9.5	4.0	1.0	1.0	1.0	#7 #47
10:50	14.1	6.0	2.5	.67	.40	#1 out @ 15.5
11:02	16.9	8.5	5.0	.47	.20	from #7
11:14	19.8	24.5	17.5	.163	.057	#1 in #6 at 16.3
11:25	20.8	71.5	47.5	~~.085~~ .052	.021	Est. cr. @ 21.5
11:32	21.5	Critical Tamper down Rod @ 17 cm.				
	21.3	" "		20 cm		
11:39	21.1	Inserted " "	Rod out.			

Conclusion: Critical @ 21.2 cm eight glass.

Zero	+ .5
Bobber	+ .9
Hc	22.6
V_c =	11.45 l
M_c =	~~1.16~~ kg. 1.17

3/6/50

N.U. 698
#/X = 240

Exp #407

Henry
Moreland
Moffett
Rohr
Rohrer.

10" Reactor Untamped.

Source, instrument & background same as #406.

Time	Sol. Ht.	#1	#2	X 1/M1	⊙ 1/M2	Remarks
	9.5	21.0	15.8	1.0	1.0	
1:25	19.8	43.5	25.0	.48	.63	#6 MT @ 29.5
1:34	25.1	56.	37.5	.375	.42	
	30.5	70.5	49.	.30	.32	#5 MT @ 43.
2:00	44.8	106. ~~86.0~~	86.0	.198	.187	
2:30	54.9	135.0	113.0	.156	.140	#4 MT @ 52.
2:44	71.9	178	168.	.118	.094	#3 MT @ 63

Maximum advisable height in cylinder

Best Estimate of criticality 105 - 145 cm ~~d~~ by extrapolation

Probably safe! Hc > 165, Vc > 53 Mc > 5.4

With Solution at reactor zero - Tamper drained
Sight glass read = 0.3 cm.

Dilution calculation - target #/X = 350

Phone analysis: Sample 830128 is 0.08851 gm U / gm Soln

See formula Pg 101

∴ present #/X is $\frac{1}{.933}\left[\frac{26.11}{0.08851} - 6(6.98) - 31.44\right] = \frac{1}{.933}\left[294.99 - 41.88 - 31.44\right]$

↑ not final values

$= \frac{221.67}{.933} = \boxed{237.6}$

Water to add is

$$(350 - 237.6)\left(\frac{9}{235}\right)(1.230)\left[(0.08851)(0.933)\right]$$

$$= \frac{(112.4)(9)(1.230)(.08258)}{235} = \frac{(1011.6)(0.1016)}{235} = \frac{102.8}{235}$$

$\boxed{= 0.437}$ cc water to add / cc present solution

∴ max. need = 37 l. for 12" untamped + DV or 6 cyls active pit

# of pails of soup $\frac{37}{1.437}$ or 25.75 l. are needed for dilution
or 4.29 l. in each of 6 cyls + add 1.875 l. water to pail

3/7/50 Dilution continued

4.29 l per cyl is $\frac{4290}{506.6}$ = 8.46 ℓ record 0.05 ca.

@ 9am #2 completely filled #7 full from yesterday #1 & #9 MT.

#2 & #7 Removed

						3 lbs on to 4 ℓ added H_2O
1:50	Drained	8.5 cm	into	#1		1.875 ℓ
	"	8.5 cm	into	#3	after emptying	1.875 ℓ
2:05	"	8.5 cm	into	#9		1.880 ℓ
	"	8.5 cm	into	#4	" "	1.875 ℓ
	"	8.5 cm	into	#5	" "	1.875 ℓ
	"	8.5 cm	"	#6		1.875 ℓ.

#1 & #3 need further mixing. i.e. some of #1 water must be in #3 ∴ pool #1 & #3 & mix these two together in reactor before adding others. [cyls A, C, E, F, G, B]

dilution completed in #'s 1, 3, 4, 5, 6, 9 | P empty in position #2 | others M, H, J, D, Q to ship

3/9/50 Inventory & H/x sample troubles. Cyl M resampled 3/8 gave colorimetric analysis 0.141 checking Pu 0.1339 taken on solution before putting it into M. This was from #9 & ∴ expected to be typical of pit & official for H/x. Recalculations of volumes etc make it apparent that the pit soup volume was if anything smaller than the original Y-12 shipment volume & ∴ H/x = 88.0 computed (Pg 101) therefrom is declared official for expts. 384 – 392. (393 & 394 yes & greater)

Tentative explanation is pptn of UNH on walls of cyl 9 before samples 830126 & 830127 were taken & solution transferred to cyl M.

Cyl. P in no. 2 position, position 7 & 8 empty

120

3/9/50

J.W. Morf. H
J. Fox
R. Macklin
C. Schuske

Exp 408
~~Exp 408~~

$H/X \simeq 35$

10" reactor ~~Lattice~~ untamped
Run primarily for mixing purposes.

Shipped
Instrument no. 6 at 6 x 1000
" 3 at 90 x 100
Photo mult. at 2" approx

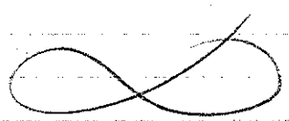
preliminary mixing – no side tamping, top tamped at 70 cms.

Time	Sol. Ht.	#1	#2	$1/M_1$	$1/M_2$	Remarks
1:00	18.3	41.0	20.0	1	1	#1+3 empty feeding from #4
1:05						working on leak
1:55						leak fixed + mixing continued
2:20						
2:24	30.5	96.0	39.5	.427	.507	#4 empty
2:33	42.3	87.0	56	.479	.351	
2:40	54.8	97.	69	.424	.290	
2:50	66.9	106	74	.387	.270	air in line (~3mm)

Drain back

1	3	4	5	6	9	
4.4 + D.V.	12.5	12.5	12.5	12.5	12.2	Lmo in 10" reactor

Conclusion: infinitely safe (multiplication probably less than 5 at $H=\infty$



3/10/50

Experiment #409

For Macklin Morfitt Henry

10° Reactor Tamped $\frac{H}{X} \simeq 350$ $\frac{N}{X^2} \simeq 7$

Trip Points: #3 91 x 100 Source: 10cm. from bottom
#6 6.8 x 1000
PM .74 at 1.5 in.

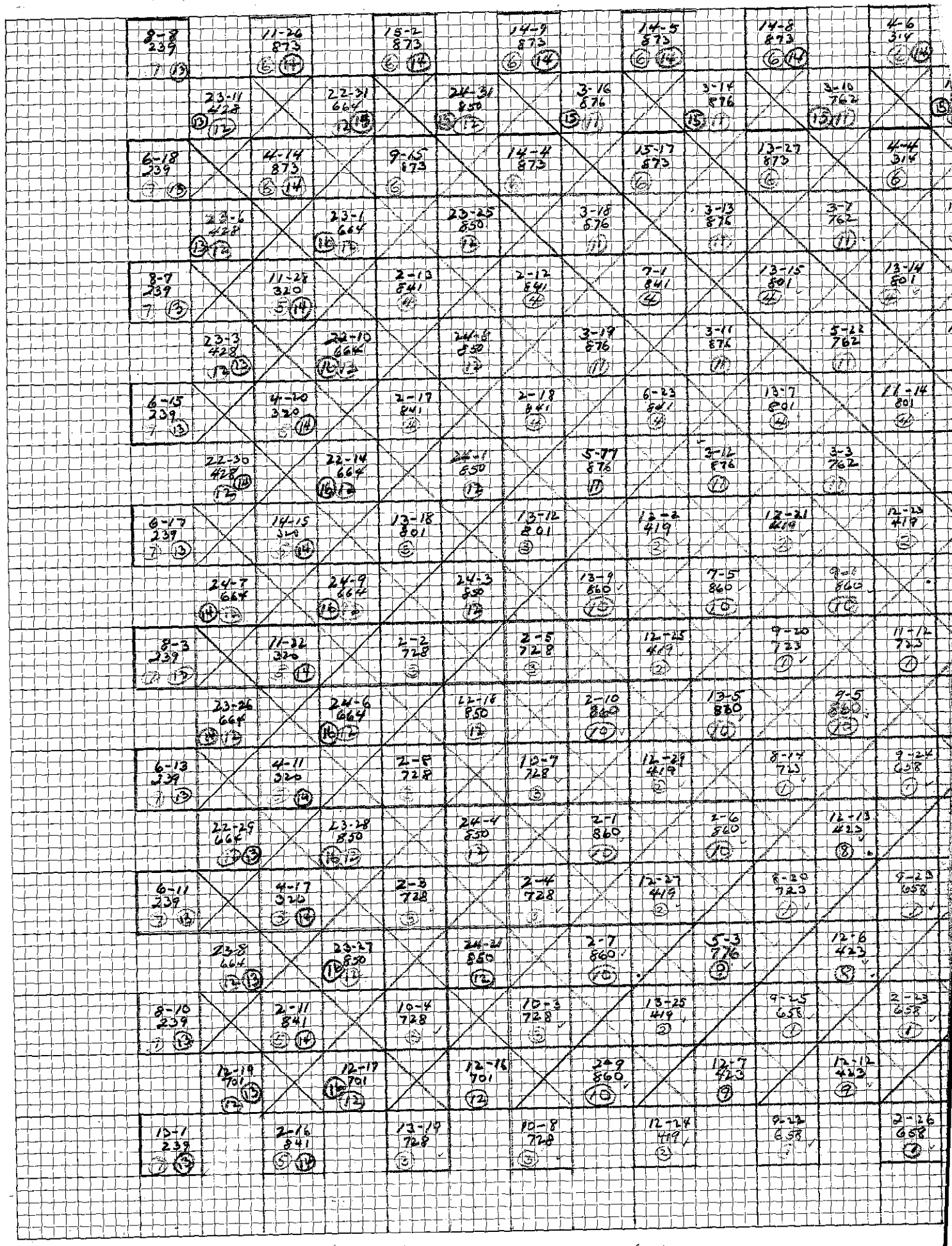
Time	Sol. Ht.	M_1	M_2	$\frac{M_1}{M_{10}}$	$\frac{M_2}{M_{20}}$	
10:50	13.8	4.5, 4.5 } 4.5	1.5, 1.5 } 1.5			#1 MT at 4.0 #9 MT at 16.0 Fill from #3
11:10	18.2	7.0	2.5	.64	.60	
12:10	24.0	20.0	12.0	.22	.12	
12:20	25.5	43.5	26.0	.103	.058	
	Rod in	15.0		.30		
12:30	27.05	Critical with rod at 22.0 (3.5 in scrap + 15.0 in tamper)				
	26.85	Critical (slightly super)				
	26.55	Subcritical				

Conclusion: Critical at 26.75 cm.

1	3	4	5	6	9
12.0	12.5	12.5	12.5	12.5	4.0 + D.W.

st Ht.	26.75
Total cor.	1.40
H_c =	28.15
V_c =	19.3
M_c =	1.05

Top



Bottom

Cont'

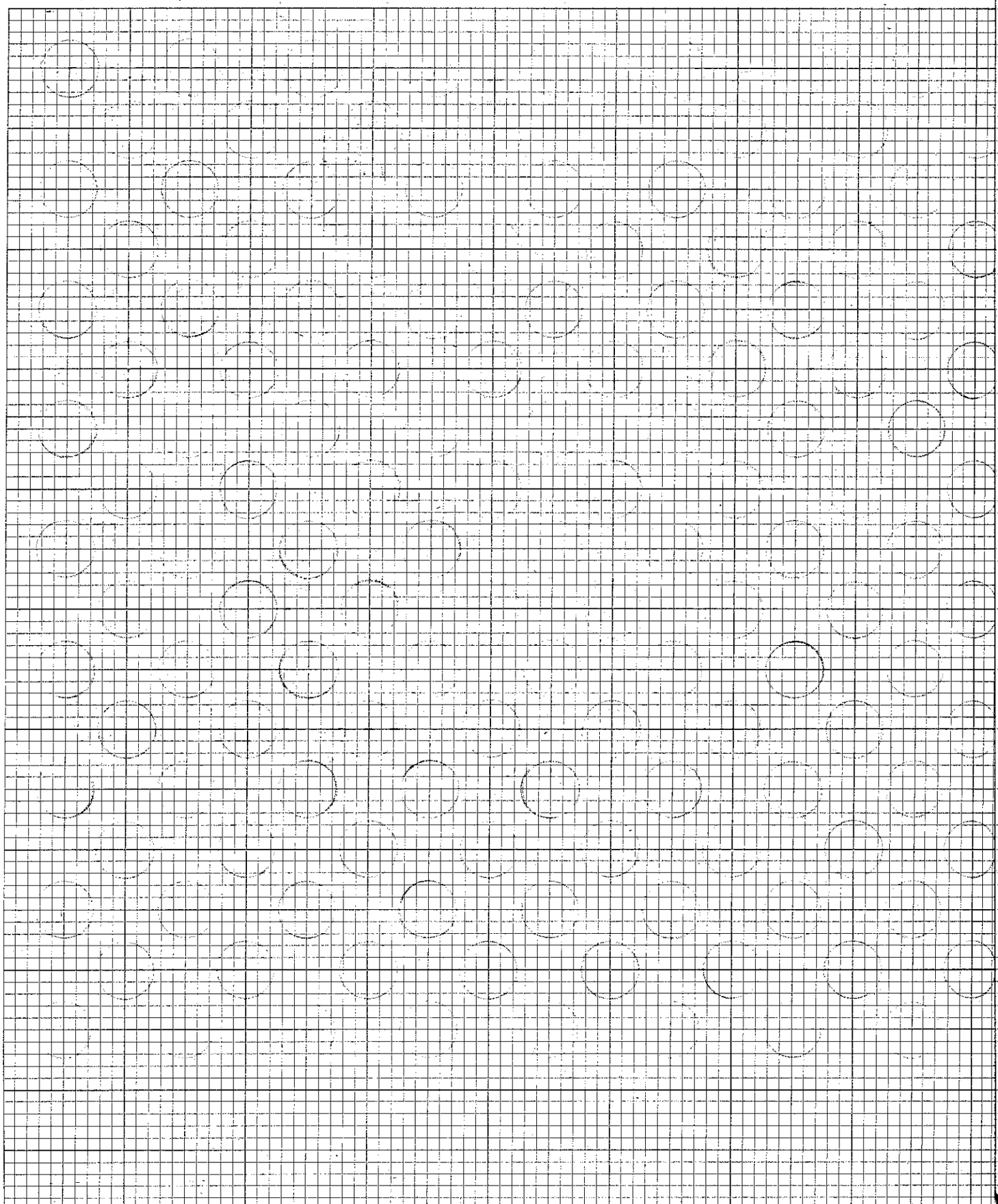
Rotated

Experiment #10

Closed End

* Source position addition 1-12 in inside face where slugs go in.

Run 13 on Source moved 3" up from below of slugs.



Cont'

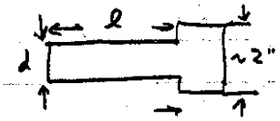
Expt #410
Critical Array 145 Slugs
Scale 1/3⅛

EXPERIMENT * 410

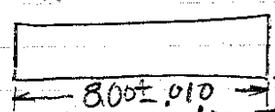
3/12/50.

MACKLIM
McLENDON
MOFFITT
CALLIHAN

To test criticality, if any, of array of U-al slugs
Slugs are ~~1.36"~~ 1.41 ± 0.005" diameter = d ; $\ell = 8.0 \pm 0.5$"
$L = 9.375 \pm 0.125$"

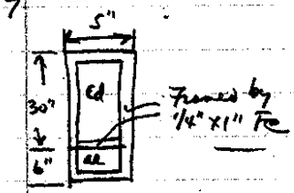


FINISHED SLUG



$d = 1.353 \pm .005$"

20 slug mounted in Lucite matrix as indicated by ① on attached plot-



Cd safety sheet - 5" x 30" Cd suspended by magnet
2 Cd control sheets - ≥ 12" x 30" (same as safety except 12" wide).

		Trip	Scale
TRIP PTS	#3	- 92 x100	x 10
	#7	- ok. (1.5")	-
	#6	5.7 x1000	25
	#4	-	~~50~~ 100
	#5	-	2

Source - 7 cm on scale - see chart for position in lattice.
Control Rods zero = #1 = 0
#2 = 3.5 cm (compensator at 88 cm).

Cont'

+ 410 (Cont)

	Conditions.		C_1	C_2		1/M.	1/M₂
12:01 P.	20 slugs No water.		33.0	20.0			
			35.0	20.0	①		
12:28 P.	20 Slugs Source covered	Water Gauge 38.6 cm	~~10.5~~ 10.5	7.5	①		
12:38 P.	20 Slugs Covered	Water Gauge 75.5 cm	2.25 3.25	9.75 1.00	②	1.0	1.0
	Project abanded for lunch.						
1:19 P	30 Slugs No water		31.0	18.5	① + ②		
	Source covered	WG 38.6 cm	9.0	8.5			
	30 Slugs covered	WG. 83.5	2.5	1.00		~1.0	~1.0
			Zeroed for 0 H₂O			#1 34.0	#2 20.0
			Zeroed for Source covered			10.5	7.0
			" " Full tank			1.75	1.25

Time	Number Slugs in.	Water Gauge	C_1	C_2	Array Used	1/M₁	1/M₂
1 48	42	0 cm.	35.00	18.5			
1 52	42	38.6	10.5	9.5			
1 55	42	83.5	2.5	1.05			
2 15	56	100.	2.25	1.00	Σ^6		
2 25	72	100	2.25	1.00	Σ^7		
2 42	90	Full!	2.5	1.50	Σ^8		
3 00	110	0	38.5	21.5	Σ^1		
3 17	110	Full!	1.75	1.25	Σ^9		
3 20	115	38.0	16.25	12.5	Σ^8	.65	.56
			3.25 ~~9.50~~	1.75, 2.00		.54	.62
			Counts #1 occasionally counts 64. Most of Time #2 counts 32.				
4 20	122	0	~~35.5~~	21.5	Σ^9		
4 35	122	Full!	~~2.5~~	~~3.6~~			
4 40	122	"	3.6*	2.5	Σ^7	.485	.500
4 55	140	0	22.0*	21.5	Σ^{10}		
5 20	140	Full!	5.3*	4.0	Σ^{10}	.333	.310
5 35	~~180~~ 160	Full!	6.5*	4.75	Σ^{11}	.269	.263
5 55	194	0	20.0*	23.	Σ^{12}		
7 15	194	Full!	> —	180,	Σ^{12}		

→ with one blade in + one blade @ ~20 cm

7 25 — 184 — At this point the slugs were rearranged. Now in lattice:

All positions filled EXCEPT Three Marked with green ⑬! This gives total of 184 slugs.

No detectable multiplication

Safety Rod was removed + Source plowed in some position as to height + lengthwise along lattice but moved about 3" towards face end of lattice where slugs are inserted.

* by actual count of interpolation curves instrument faulty.

Time	Number Slugs	Water Gage	Control Rod 1	CR #2	
7:37	184	80	48	0	Critical
~~7:39~~	~~[redacted]~~		Source Out.		
7:40	162	All positions except GREEN (13) & (14)			
8:00	162	85	Subcritical Rods & Source Out.		
8:14	153	All position with GREEN (13) (14) (15) Removed.			
8:16	153	82.5	Subcritical		
8:17	153	86.1	Critical @ 45.5 Rod #1 #2 Rod in.		
8:22	145	Water 98"	Critical + Rods out source out		

Appears to be critical or slightly supercritical

See sketch of loading positions & loading schedule on following pages.

Conclusion:

145 slugs in 9 x 9 square lattice + 8 x 8 lattice four centered with respect to above is critical when completely water loaded.

3/14/50

Experiment #411

Cronin
Fox
Mackin
Morfitt
Rohr

12" Reactor Untamped H/X ≈ 350 H/U ≈ 7.

	Start @	Trip @
#3	X100	85 X 100
#4	NG	
#5	X1	
#6	X25	6 cm Pb 8 cm sensitive 1½"
#7	—	

Background for Tamped } 5.5, 5.0 #1
2.5, 3.5 #2

Untamped } 28.5 26.5 #1
21.0 19.0 #2

Time	Soln Hyg	#1	#2	X 1/M	⊙ 1/M	Remarks
10:37	10.6	27.5	20.0	1.0	1.0	SMT @ 2.5
10:45	19.9	39.5	26.0	.70	.77	6MT @ 11.0
11:00	32.2	327.0 325.0	218.0 215	.084	.092	5MT @ 19.9 4MT @ 28.5
11:24	Rod in.	244	145	.125	.138	Stopped #3 from #1
		Rod withdrawn 5 mm.		.068		
11:28	33.5	404	277	.066	.072	
11:37	35.4	670	466	.044	.043	
		460	290	Rod withdrawn 1.9 cm.		

11:50	38.7	Sub-Critical Rod out.
	39.3	Critical with CR at 31 cm from bottom
	39.1	" " CR at 35 cm
	38.8	Sub-Critical

Critical at 38.9 ± 1mm on right Glass.

+.7
+.6

$H_c = 40.2$

$V_c = 29.3$ ℓ

$M_c = 2.14$ kg

$H/X = 327$

3/14/50

Experiment #12

12" Reactor Tamped H/X = 350 H/U = 7

Crowe
Fuf
Meaker
Morfitt
Rohr

Instrument & Sources as in #11.
14.85 cm before borg. 14.6 after borg.

Time	Soln Hgt.	#1	#2 2.5	1/M.	1/M₂	Remarks
—	10.0	5.25	[redacted]	1.0	1.0	#4 + 6 M.T.
1 15	14.6	8.0	3.0	.65	.83	from #5
1 24	18.0	46.	21.0	.114	.119	
	Rod in	17.0		.31		stopped #5
1 30	19.2	Supercritical	Rod @ 10			from #3
1 34	19.0	"	Rod @ 13			
1 36	18.8	"	Rod @ 18			
	18.6	"	Rod @ 20			
	18.4	Sub-critical				

Critical at 18.5 ± 0.1 cm on sight glass.

Sight Glass reads 0.7 cm below 0 on scale when soln level in reactor at zero & no water in Tamper tank.

Ht. Sl. ht.	18.50
Zero	.9
Bot.	.6
H_c =	20.0
V_c =	19,59.6
M_c =	1.07

$H/X = 327$

3/15/50

Fox
McLendon
Morfitt
Bortkus

Experiment 413

15" Reactor Tamped $H/x = 350$ $H/U = 7$

	#1	#2
Background for Tamped	8.0	2.0
" " Untamped	7.0	2.0
Source @ 5 cm from bottom	#1	#2
	25	9.5
	25	9.5

Solution Inventory

#1	#3	#4	#5	#6	#9
5.	5	5	4.5	5	DV + 1cm

Instrument	Start @	Tamper @
3	X10	85X100
4	NG	———
5	X2	———
6	X25	6.1 X1000
7	———	1½" ⊙

Time	Soln Hgt		#1	#2	1/M	1/M²	Remarks
9²⁹	7.5		7.5	2.0	1.0	1.0	@ 7.0 #9 MT #6 MT
* 11⁰⁷	12.1		20.5	5.5	.39	.45	from #5 MT @ 120
11¹⁶	13.4		32.	10.0	.235	.20	from #4
11²²	14.5		92.5	32.5	.081	.0615	
		Rod in	38.	11.5	.198	.174	
11³⁵	15.1		Critical Tamper Down, Rod @ 15 cm				
11³⁷	14.9		"				" " 20 cm
11³⁹	14.7		Subcritical				

Conclusion: Critical @ 14.8 on scaled glass.

Zero Cor.	-.1
Bot "	+.4
Hc	15.1
Vc	17.2 ℓ ✓
Mc	1.26 kg. ✓

$H/x = 327$

* Instrument Trouble.

3/15/50

EXPERIMENT # 414

15" Al. REACTOR - UNTAMPED $H/X \sim 350$; $H/O \sim 7.0$

INSTRUMENTS & SOURCE AS in #413. —

TIME	SOLN HT	#1	#2	× 1/M1	⊙ 1/N2	REMARKS —
	7.5	25.0	9.5	—	—	BACK GROUND —
2:00 pm.	14.9	44, 45	19, 19.5	.56	.489	
2:21	18.0	63.	30	.397	.317	#4 MT @ 18 cm
2:30	22.0	134	73	.186	.130	from #3 Stopped @ 23.5
2:42	24.0	377	227	.066	.042	from #1
	Rod in.	220	110	.113	.085	Rod worth 9 cm.
3:25	26.0	Critical Rod @ 23 cm.				
3:30	24.95	Sub critical Rod out.				

Conclusion: Critical @ 24.95 cm on sight glass.

Solution level zeros at sight glass = +0.3 cm.
Tamper tank empty.

Sight Gl. ht	24.95
Zero.	−.30
Bot	+.4
	$H_c = 25.05$ ✓
	$V_c = 28.$ ✓
	$M_c = 2.09$ kg. ✓

$H/X = 927$

3/24/50

Exp. 415

Fox
Morfitt
Cronin

Phosphate - 4 vinyl pyridine sol'n P/X = 50 H/X = 2.8 H/X = 300

15" Stainless Steel Reactor Untamped

Source @ 10 cm from bottom

Trip Point

#3	80 × 100	
4	——	
5	——	
6	6.2 × 1000	
7	— Trips	

Starting scales.

#3 × 100					
#4 × 5					
5 × 1					
6 × 25					
7 —				X	⊙

Time	Sol'n Ht.	#1	#2	1/M.	1/cm	Remarks.
2:00	12.6	24.5 25.5, 26.0, 24 (25.0)	9.0, 10 9.5 (9.5)	1.0	1.0	1.5 cm each from
3:05	20.2	55.5	19.0	.45	.50	#1MT @ 15 cm
3:20	25.3	80	32.0	.31	.295	1 cm from #2 & #3 .05, #7 .8 Dy
3:40	33.5	154	74.0	.163	.148	#4MT #5MT
3:58	40.6	478	267	.053	.036	#8MT #78MT
	Rod in	274	140	.091	.068	#6MT
	44.5	Critical Rod @ 30.0				
	44.10	Critical Rod @ 39.0				
	43.85					1/cm = #2

Conclusion: Critical 43.90 cm on eight glass.

Inventory cm on 15" cylinder.

#1	2	3	4	5	6	7	8	9
6.4	6.4	6.3	6.3	6.4	6.4	6.4	5.3	DV + 1 cm.

Eight Glass crit Ht. 43.90

Zero. ~~Hc~~ cor — 1.10

+ .40

Hc 43.20

Vc 99.2 ~~X~~ l

Mc ~~2.72~~ Kg. 2.72

H/X = 316.0

P/L = 4956

N/L = 2.71

sp. gr. 1.445

gm/cc = .0364 × 1.645 = .05927

132

3/27/50 Ex 416

Rohs — 15" Stainless Steel Reactor Water tamped

Fox Cronin — P/X n 50 M/X n 2.8 H/X n 300

Source at 10 cm ~~B~~ from bottom

	MT 1	MT 2	MT 3	4	5	6	7	MT 8	9
Solution Inventory = in 15" cyl	6.4	6.4	6.3	6.3	6.4	6.4	6.4	5.3	DU + 1cm

Instruments	Stand	Trip		
#3	x 10	75 + 100		
#4		—		
#5	x 1	—		
#6	x 25	6 x 1000		
#7	—	trips	⊙ c0/c1	⊕ c0/c2

Time	~~xx~~	#1	~~#2~~	~~2~~			
10:25	1cm						#9 MT
10:29	6 cm.						#8 MT
10:45	11.6	8.0 } 7.75	17 } 1				
		7.5 }	1 }				
10:55	12.0						#3 MT
11:00	16.5	10.5	3.0		.748	.33	
11:10	~~19.3~~ ~~18.0~~	14	3.25		.553	.31	#2 MT @ 18
11:32		32	10		.242	.10	
11:44	26.5	134	52		.0192	.058	#4 MT @ 24.5
11.50 Rod in		39	11.5		.198	.087	
12:04	27.45	Super	Rod at 20				
12:16	27.1	Sub					Stopped #5

Conclusion crit at 27.25 ± .1 cm

Total cor. − .50

Hc 26.75 ~~.68~~

Vc 30.~~47~~ 46

Mc ~~1.81~~ 1.69 ✓ Kg.

H/X = 31 cm D

P/u = 49.56

EX. 417

Cronin
Fox
Rohr

15" SS REACTOR TOP TAMPER UP (@ 73CM.)

SAME INSTRUMENTS as 416
$P/_X \sim 50$ $H/_X \approx 300$
$H/_X = 316$

TIME	Hz.	#1	#2	C_0/C_1	C_0/C_2	
1220	27.1 ~~41~~	41	19	.189	.0526	
1227	28.5	82	38	.094	.0266	Feeding from #6
1240	30.2	Super	Rod at 23			
	30.0	Super	Rod out			
	29.9	Sub				

conclusion critical at 29.95 ± .05 – cm.

cor.	-.5
H_c	29.45
	6
U_c	33.57
M_k	~~1.94~~ 1.86 kg.

$H/_X = 316$

$P/_U = 99.5$

134 3/28/60

Rohrer

Ex 418

1140
934
604

for Madelia Morfitt Cronin

P:U = 49.5 = 50 N:U = 2.8 H/U = 316.0 = 300

with 10⁶ tubes filled with 5% HNO_3 in water by volume

15" Stainless Steel Reactor water tamped no top tamper

Inventory

	MT #1	MT 2	MT 3	MT 4	MT 5	MT 6 ✓	MT 7	MT 8	MT 9
	~~6.4~~	~~6.4~~							
	12.05	12.05	12.05	12.05	12	12.05	12	10	DV+2

Drainback — cm cm

Source at 20 cm using outside control rod

Instruments	Startsky	Trip Pts
#3	×100	84 ×100
#4	×5	—
#5	×1	—
#6	×25	6 ×1000
#7	—	trips

Time	Sol'n HT	#1	#2	⊙ C_0/C_1	× C_0/C_2
3⁰⁰ PM	23.2	7.0	1.5		
		7.0	2.0		
3¹⁵ PM	30.2	9.0	2.5	.78	.80
3³⁰ PM	45.5	13.5	4.5	.54	.45
3⁴³ PM	60.3	16.5	8.5	.425	.235
4¹³ PM	67.3	14.5	8.0	.48	.25 (tubes floating previously)
4²⁰ PM Morfitt Cronin	59.5	14.0 ~~13.5~~	7.5	.50	.27
4²² PM	45.3	11.5	4.5	.61	.45
4⁴⁰ PM	29.7	8.5	3.0	.82	.67
5⁰⁰ PM.	23.1	7.0	2.0	1.0	1.0
		6.5	3.5		

Conclusion: Reactor appears to be safe even if filled to any height.

Analysis:

A sample Th# 830158
P = 23.14% by wt.
NO_3 = 2.55%
U = .03594 gm/gm sample Th. 830159
x = 93.20

B.

3/29/50

Ex 419

= 49.54

Moffitt McSedas Top Cronin

P:U = 50 N:U = 2.71/2.8 H/X = 300 = 316

with 9 1.06 tubes filled with H_3PO_4 + 5% HNO_3 by volume approx P:U of 100 (85%)

15" stainless steel Reactor no top tamper

Instruments

	Stand scale	Trips	
#3	×100	85×100	
4	~~×10~~ ×5	—	Source at 20 cm
5	×1	—	using outside
6	×25	6.2×1000	Control Rod
7	—	trips	

Solution	Inventory	#1	#2	#3	#4	#5	#6	#7	#8	#9
		MT@ 12.05	12.05	12.05	60.5 12.05	#9. 12.05	MT@36.9 12.05	MT@24.8 12	MT 10	MT DUT 2

Sample taken by adding to DV - approx 1 liter from each cyl and mixing.

Time	~~Ht~~	#1	#2	X c_1	⊙ c_2
2:20PM	23.2 cm	6.0	1.5	1.0	1.0
		6.0	1.5		
		6.0	1.25		
2:32PM	30.0	7.5	~~2.0~~ 1.75	.80	.86
2:47	45.7	9.5, 10.5	4.75, ~~3.5~~ 3.5	.63, .57	.32, .46
3:02	60.2	11.0	5.5	.545	.27
3:16	67.3	11.0	6.0	.545	.25

Conclusion: Reactor appears to be safe even if filled to any height. System if anything is less reactive than ~~that~~ of #48.

7PM- Moffitt says DV in #3; each other cylinder has 6 cm in empty 15 cm cylindrical reactor.

DC

3/29/50 — Exp 420

Rohr. — To expose some foils for Rh at steady flux for an extended time

Cashion
Henry

15" reactor, H_3PO_4 filled tubes removed, untamped. same relation as in 419.

TRIP counts
#3 – 90 x 100
#6 – 6.5 x 100
#7 – 0

Det Scales
#3 x 100
#4 x 5
#5 x 1
#6 x 25

Source 14 cm above reactor bottom = 22.5 on scale
Using 3/4" Cd rod in relation for control.

8:05P — DY filled from #3.
10 — #3 Emptied at 4.0 cm, Filling from #1.
18 — #1 " " 9.7 " Filling from #9.

	H	C_1	C_2	M		
35	16.7 cm	~~18.0~~ 18.5	17.0?			#9 Emptied, Filling from #8
50	23.3	30.5	17.0	0.61	[0.61 → C_{20} = 103]	#8 Emptied, Filling from #7
9:07	29.4	38.0	44.5	0.32	0.38	#7 Emptied, Filling from #6
22	35.2	103	96.0	0.18	~~0.18~~ 0.16	#6 Emptied, Filling from #5
37	~~41.0~~ 41.1	274	298	0.07	0.06	#5 " " " 2
	45.2	Slightly sub-critical				
	45.1	Critical with rod at 28.0				
10:11	—	Foils placed with safety & control rods in and with source out – no sign of a change in levels due to tamper of personnel				
10:18	—	Radiation level (neutron) brought to 60 x 100 on #3 meter and maintained constant. (6 x 1000 on #6)				
11:20		Radiation at rate of 8 mr/hr at end of temper tank nearest control room				
11:59		Control rod & safety rod in; foils removed;				
12:23		New foils placed and reactor started toward critical				
12:38		Radiation level (neutron) brought to 80 x 100 on #3 and maintained; #6 is off-scale on 1000. Critical with rod at 29.5 cm.				
1:20		Critical with rod at 30.0. Level still 80 x 100 on #3				
2:20	45.7	Critical with rod at 30.5. Level as above				

Drain back:

Into	#2	ø 41.0	(Cms. in 15" reactor with framing for tubes)
Into	#5	to 35.5	
"	#6	to 29.4	
"	#7	to 22.8	
"	#8	" 16.3	
"	#9	" 9.7	
"	#1	" 3.8	
"	#3	" remainder	

Installed 3% tubes of H_3PO_4 in lattice.

~~Out.~~

138

3/24/50

Exp # 421 H/U = 300 = 316 P/U = 50 = 49.56

Callihan Cronin Fox Morelli Marfetta

15" Reactor side & bottom Tamping only. 36 ~~tubes~~ filled with H_3PO_4 + 5% HNO_3 in pattern as per page 108.

Instruments	Start @	Trips @
3	X100	92 x 100
4	X5	4 X100 ~~Bypass~~
5	X1	
6	X25	6 1/2 x 100
7		Trips

Source @ 12 cm.

Time	Sola Hgt.	#1	#2	1/M	1/M	9 MT @ 6
8:45	14.6	any 5.0	2.0 any	1.0	1.0	.8 MT from #7
8:55	20.0	7.5	3.0	.66	.66	#7 MTab 21.2
9:15	28.2	11.0	4.5	.455	.445	from #6 6 MTab 28.6
9:25	35.0	32.0	23.0	.156	.087	from #5
	Rod in	90.0		.170		~~stopped~~ #5
9:40	36.5	90.0	68.0	.055	.029	~~started~~ #4
	Rod In	58		.086		
	37.4	Super Crit. Rod ab 40				
	37.3	Critical Rod out.				
	37.25	Sub Critical Rod out.				

Critical at [redacted] (~~[redacted]~~ 37.3 ± 0.1 cm

Zero in reactor gives +1.1 cm on S.G. (Tampa tank drained)

Drainhole 15" cm

1	2	3	4	5	6	7	8	9
6.4	6.4	6.4	6.4	6.4	6.4	6.4	DV + 8 cm	

Right Plan Crit Ht. 37.30

Bot. + Zero Cor ~~Total Cor~~ -.50

Bot. Plate Cor ~~Hc~~ 36.80

~~Hc~~ - .94

Hc = 35.86

Vc = 34.26

Mc ~~2.03~~ Kg.

~~1.89~~

.190

9.4
.50
1.44

37.30
- 1.44
35.86

Area of tube
5.066 x 36 = 182.37 cm²
rods 2.14
184.51

1190.0
184.5
955.5

4/3/50 Exp 422 H/L ~ 300 = 316 P/V ~ 50 = 49.5%

for 12" Stainless Reactor complete water reflector

Cronin Mackin

Source at 12 cm

Instruments	Start	Trip
3	×100	92 ×100
4	×5	—
5	×1	—
6	×25	6½ ×1000
7	—	Trips

Sol'n ~~Inventory~~	#1	#2	#3	#4	#5	#6	#7	#8	#9
	10 cm	10 cm	10 cm	10 cm	10 cm	10 cm	10 cm	18 cm	DV
			○	○	MT	MT	MT	MT	MT

Time	Sol'n Ht	#1	#2	1/M₁	1/M₂	
10 33	12.3 (BB3x)	~ 5.5	~ 1.0	1.0	1.0	3x Blown Back from 13.1
10 46	16.1					7 MT @ 16.1
10 50	22.3 (BB)	9.5	2.0	0.58 ~~0.172~~	0.50	small rises on #6 (R5x)
11 02	26.2					#6 cyl empty
11 10	29.2 (29.3)	12.5	3.0	.44	0.33	#6 mat'l to 50X
11 22	36.3					#5 MT #6 @ 100x
11 25	39.0 (38.9)	32.5	12.5	.17	.08	good rises #6 @ 200x
11 37	42.0	97.5	41.5	.056	.024	#6 @ 500x
11 44	42.0 (rod in)	45.0		.12		rod worth 1.7 cm
11 45	42.0 (rod in Tamper out)	30.0		.18		rod + tamper worth 3.3 cm
11 48	43.5 (43.6)	Very slightly subcritical (Rod out)				feed for #3
11 54	43.8 (43.9) (before) (after)	Super w Rod ~ 36 cm from bottom				

12" SS Reactor in at 0 when sight glass reads 1.0 cm (no H₂O in Tank)
Critical @ 43.65 ± 0.15 on Sight glass

Drain back approx as before

zero in cylinder reads 1 cm on sight-glass - no water in tamper DK 1/7.

~~-.8 Bot. zero~~
~~+.65~~
~~-.15~~

sight gl. 43.65
total −.15
43.50

Hc = 43.50
Vc = 31.74
Mc = ~~1.88~~ 1.75 ✓

H/L = 316.0
P/L = 49.5%

4/4/50

Exp 423

Fox

10" Al H/X = 300 P/U = 50 N/U = 2.8

Machlin
Cronin

completely evacuated tamped

Analysis data:
H/X = 316.2
P/U = 49.5%
N/U = 2.71

Source at 20 cm

Instruments	Start	Trip
#3	x100	92 x100
#4	x5	—
#5	x1	—
#6	x25	6.4 x1000
#7	—	2"
#8	—	

Solution Inventory

1	2	3	4	5	6	7	8	9
13.7	13.7	13.7	13.7	13.7	13.7	13.7	11.5	DV + 1cm
		(O)	(MT)	(MT)	(MT)	(MT)	(MT)	(MT)

Time	Soln Ht.	#1	#2	1/M1	1/M2	
9:10	DV	3.0	1.5			#9 MT
	R	3.5 (2.5)	1.0 (1.5)			#8 MT at 12 cm
9:23 AM	22.5	4.0	1.5			from #7
9:40 AM	41.2	6.5	3.5	.54	.43	#7 MT at 26.5
9:55 AM	55.3	8.0	7.0	.44	.21	#6 MT 41.2
10:05 AM	65.3	10.0	8.0	.35	.178	#5 MT 48.5
	73.3	12.0	10.5	.28	.143	#4 MT 65.3

System sub-critical at 73.3 (maximum in cyl)
1/M extrapolates to 105 cm as critical.

#1 counter = 105 cm
#2 counter = 104 cm

103.5 +.93 +.1

zero in cylinder is −0.1 cm on sight glass

Hc ~ 104.5
Vc ~ 52.9
Mc ~ ~~3.14~~ kg. 2.93 ✓

H/X = 316.0 P/U = 49.5%

Sample from 830169 8168
→ U = .03553
NO_3 2.54 % ± ~~.0?~~ .573% N
P = 23.24%
Sample from cyl. F during inventory & shipping

4/11/50 — Exp 424

Fox — 10" Al H/X = 80 P:U = 7 N:U = 2.8

Madden Cronin — contamped (for mixing purposes.

Source at 7 cm

Instrument	Steps	Trip
#3	×100	92×100
4	×5	—
5	×1	—
6	×25	7×1000
7	—	1"

Sol'n Inventory: (A) 2 — 348 g, 48 cm; 3; 4; (B) 5 — 420 gm, 48 cm; 6; (C) 7 — 1422 g, 9 12 cm; 8; (D) 9 — 1531 gm, ≈ 12 cm

10:10 Emptying #9

11:00 #9 M T

11:30 #7 feeding

Valve on #2 position leaked. replaced with new value

				$1/M_1$	$1/M_2$
12:08	HB	#1	#2		
12:15	10.2 (3× blackback from 9:7)	32.0	11.0		

#7 stopped flow – added small amt H_2O to clear line

1:15	23.4	48	20.5	.66	.54

7+9 added more water to rinse out possibly clogged line after continued blended.

2:05	28.6	54.5	24.5	.59	.45

$1/M$ Curve extrapolated gives critical values: #1 = 61.0 cm, #2 = 52.5 cm } avg = 56.8 cm ± 5? cm

avg Sp. Gr. = 1.50 from final shipment

$Hc \sim 56.8 \pm 5.0$

$Vc \sim 28.8$ liters

$Mc \sim$ ~~3.76~~ 3.24 Kg

$\frac{H}{X} = 156.7$

$N/U = 5.01$

$P/U = 14.77$

10.65% NO_3 – 830184

15.69% P

.0805 gm U/gm

142 4/11/50

Exp 425 A

Top — 10" Al cyl H/X ≈ 80-100 P/U ≈ 7 — H/X = 156.07

Cronin — Completely water tamped. — P/u = 14.77

N/u = 5.01

Source at 7 cm

Instruments same as Exp 424

Background with T. Tamper up. #1: 5.5, 5.0 #2: 3.0, 3.0

Time	Sol'n Ht	#1	#2	1/M	1/M₂	
2:30	10.0 cm	6.0	1.75			
2:35	19.7	13.5	5.0	.44	.24	
2:45	23.1	26.0	11.5	.23	.10	
		18.0	8.5	.33	.14	Top Tamper up 5 cm
3:00	25.2	277.5	138.5	.021	.0085	
		44.0	20.0	.136	.06	Top Tamper up 5 cm
		17.5	Control Rod in + tamper up.			
3:05	25.5	Critical with Rod at 26 cm				Bat cor. +.95 zero +.3 = 1.25

Critical at 25.35 ± 0.15 cm on eight glass

Hc = 26.60 (+1.25) Vc = 13.47 v Mc = 1.52 v

Exp ~~425~~ 425 B Top Removed

3:15	26.9	47.5	26.5	.105	.11
3:25	28.1	159.5	94.5	.031	.03
3:32	22.7	15.0	7.5	.33	.40

extrapolated to crit height 28.6 cm on eight glass

Hc 27.85 (+1.25) Vc = 14.10 l

Drainbocks

#2	#5	#7	#9
10 cm	10 cm	8 cm	D.V.

Mc = 1.59 v

St. Glen reads −1 mr at reactor zero

4/12/50

Expt 426 A

Mc Jordon 15" SS cyl ~~80-120?~~ [redacted]

~~Complete with tamper~~ Untamped

Cronin Rohrer Fox

source at 5cm

Inf Counter: #7-2" ; #3-88 ; #6-6

Marking reader: #5-1 ; #3-100 ; #6-25 ; #4-10

		#1	#2
2d HT 9.0 approx	Background with tamper up	22.5	10.0
		20.5 (22.0)	10.5 (10.0)
		22.0	10.0

9, 8, 7 & 6 Empty - also 5 & 2.

		C_1	C_2	C_1/C_1	C_2/C_2	
3:37	(Col. HD. 13.0	31.0	14.5	.71	.69	4 Empty
	15.7	43.0	21.5	.51	.46	
3:57	17.7	57.0	32.5	.38	.31	

426B

For Cronin Cacchi

Prior to above exp (426A) it was necessary to add water in order to put solids back into solution. Stirring was done above & after drain back air was bubbled through cylinder - This experiment will homogenize the sol & estimate unbumped critical mass.

				M^{-1}		
4:40P	H = 8.0cm	#1 C_0 = 22.0	#2 10.0	#1	#2	#2, 3, 4 Empty, #7 Empty, #5 Empty, #9 -
	= 8.8					
50	= 14.9 after drain back	36.5	16.5	0.61	0.61	
59	= 19.4	58.0	32.5	0.38	0.31	
	= 19.4	47.0	23.0	0.47	0.44	

Extrapolated Critical Height < 27.5 cm > 24. ~ 25.5

Dimensions -

#2 - 5cm in 15" reactor

#5 - 5 - - - - -

Sp Gr. 1.052

sightglass	- 0.9 cm
	24.6
bottom	+ .41
H_c	= 25.0 cm
V_c	28.5 liters
M_c	3.1. Kg ✓

H/X = 180 P/U = 11.58 ; N/U = 5.13 N/X = 5.50

144
4/12/50

Use 2

#427 A.

For
CRONIN
CALLIHAN

15" Stainless Rocta Tamped.

Dark sh as in 426 - (Hot Warm water in tamper).

		Background:	#1 6.0	#2 1.5		
			6.0	1.5		
5:35P	H: 9.0 cm.		6.0	1.5		
38	= 14.4		18.5	6.0	0.32	0.25
50	= 15.6		34.0	13.0	0.18	0.12
55	= 16.5		102	45	0.06	0.03
	= 17.0	Critical with rod element out in.				
6:05	= 16.8	Sub critical rod out.				

#5 Empty

CRITICAL WITH SIGHT GLASS = 16.9.

16.9
- .9
16.0
+ .41
16.4

16.9
- .49
Hc 16.41
Vc 17.56
Mc 1.89 ✓

427 B.

Removed top tamper -

6:07	H = 16.8	22	8	0.27	0.19
14	= 18.0	34	15	0.18	0.10
26	= ~~19.3~~ 19.2	273	132	0.02	0.01

Out of solution

Extrapolated Critical Height - sight glass = 19.35 cm - (good Extrapolation).

Inventory: # 9 - 6 cm in 15" reactor.
5 - 6 " " "
7 - 6 " "
9 - 1 " " + D.V.

19.35
sightglass - .90
18.45
bottom + .41
Hc = 18.86 ✓
Vc 21.5 ✓
Mc 2.31 ✓

Zero in 15" cyl reads 0.9cm on sight glass.
DAC + JKT

Sample taken ~~4/13/50~~ 4/13/50 from manifold
.0812 gm U/gm

830185
.0812 gm U/gm
NO_3 - 10.97%
P - 12.42%

Sp g (Calc) 1.42 g/cc.
g U235/cc .1075 =

4/13/50 Exp 428

Cronin for Mocklin — 15" Stainless Reactor with 106 tubes with 5% H_3BO_3 (250 c.c per tube)

H/X ≈ 150 P:U ≈ 7 N:U ≈ 6

Source at 9 cm

Warm water in tamper 20-23°C

Instruments:

	Trips	Start
3	92×100	×100
4	—	×10
5	—	×1
6	6.5×1000	×25
7	~~L "trip~~	+

Sol'n Inventory	2	5	MT 7	MT 9
	11.4 cm	11.4	11.4	dv + 1.9 cm

Time ~~Sol'n HT~~	~~Sol'n HT~~	#1	#2	$1/M_1$	$1/M_2$	
12:20	8.9	6= 6.0	6= 1.5			
12:30	19.6	14.0	5.0	.43	.30	
12:45	22.7	31.5	12.5	.19	.12	stopped #5
12:52	24.2	48.0	22.	.125	.068	Control Rod in
		68.	32.0	.088	.047	
1:00	25.5	Rod 21 cm out	Critical			
	25.3	Rod 40 cm out	Critical			
	25.20	Sub Critical				

Critical at 25.25 ± 0.5 cm on sight glass

sight glass −.90 zero corr.

24.35

corr. −.24

H_c 24.1

V_c 14.16

M_c ~~1.88~~ 1.77 kg

Cor. −.94 for Plate

+ .70 to bottom Pipe

−.24

H/X with tubes = 127.6

H/X of sol'n only = ~~127.6~~ 126.

P/U = 14.74

N/U^{235} = 6.97

4/6/50

Exp. 429

Cronin

15" Stainless Reactor

Top Maddin

Untamped with 106 tubes with 5% HNO_3 same as Ex 428 other case

$C_0 = 20$ $C_0 = 10$

Time	Soln Ht	#1	#2	$1/m_1$	$1/m_2$
1:25	25.5	108	57	.18	.17
1:40	27.4	130	72.5	.15	.138
1:50	30.3	195	121	.10	.08
2:00	32.5	303	204	.067	.05
2:05	36.3	sub critical rod out			
2:10	36.8	Critical Rod at 28.0			
	~~36.6~~ 36.50	just Critical rod out			

2:15 Critical at 36.50 ± 0.1 cm

$P/U = 14.74$

$-.90$

Drainback 35.40

$N/U^{235} = 6.97$

$-.24$

$H_c = 35.16$ ✓

Soln $H/X = 127.6$

$V_c = 21.3$

$M_c = 2.56$ kg ✓

4/13/50

Exp 430

Orwin, Maddin, Fox — 15" Stainless Reactor with 1/3 lattice with 52% HNO_3 in tube. Tamped except for top

$H/\bar{H} = 127.6$
$\bar{H}/U = 14.74$
$N/U^{235} = 6.97$

$C_0 = 7.5$ $C_0 = 3.5$

Time	Sol'n Ht	#1	#2	1/m	1/m₂	
3:30	9.4					20.78
3:25	16.4	14.0	7.5	.53	.46	1.14
3:45	20.2	95.6	50.5	.08	.07	H_c - 19.64
3:50	21.0	Critical Rod at 11.5				V_c - 18.8
3:52	20.8	Critical Rod out (slightly super)				M_c - 2.28 Kg
	20.75	Sub critical rod out				

critical at 20.775 ± 0.05 cm

Exp 431

Same as above untamped

$C_0 = 27$ $C_0 = 18$

3:55	20.9	100.5	55.5	1/27	.32
9:05	23.3	155.5	94.0	.174	.19
9:10	16.4	55	25	.47	.72

extrapolate to 26 - 28 cm avg = 27.0 cm ± 1 cm

Drainbacks
2 5 7 9
7cm 7cm 7cm DV + 2.4 cm (including SG zero & bottom plate errors)

27.0
1.14
H_c = 26.9 ?
V_c = 25.70
M_c = 3.34 ✓

25.9 = H_c
24.7
3.0 1K7 Rating

4/14/50

Cronin
Fox
Rohrer

Untamped

Exp 432

15" Stainless Reactor with 1/3 lattice with H_3PO_4 in ±5% tubes (250 cc. per tube)
~~Tamped except for top.~~
Untamped.

Source at ~~4~~ 7 cm.

$\frac{H}{X}$ of sol'n = ~~13.64~~ 14.21 | 13.2

$\frac{P}{U}$ of sol'n = 14.74

$\frac{N}{U}$ of sol'n = ~~6.~~ 6.50

$\frac{N}{X}$ of sol'n = 6.97

Instruments:

	trip	start
3	90x100	x100
4	—	x10
5	—	x1
6	6.5x1000	x≥5
7	2"	—

Solution Inventory

	2	5	7	9		
	7 cm	7cm	7cm	DV+2.4cm		
Time	Sol. Ht	#1	#2	1/M₁ ○	1/M₂ ×	Remarks
1021	9.5 cm	24.5 / 26.0 (25)	14.5 (14.0) / 13.5			#4 empty feed from 7
1024	9.7 cm	—	—		—	7 empty
1030	16.1	48.5	21.0	.51	.66	
1035	16.9	—	—			5 empty
1040	21.2	86.0	42.5	.29	.33	
1050	23.9	128.5	74.0	.19	.19	2 empty

Critical ht. extrapolated to be between 27.3 & 28.7 cm.
Approx. avg: 28.0 cm. ± 0.7 cm.

Drain back:

2	5	7	9
23.9	16.9		
16.9	9.5	empty	empty
7 cm.	7.4 cm		

28.0
1.14
Hc 26.86 ✓
Vc 25.6 ✓
Mc 3.07

Exp 428, 429, 430, 431 — colorimet. .0884 gm U/gm — Sample Nr. 830187
precision .08535 gm U/gm — 830186
.08535

Analysis.

4/14/50

Exp 433

Cronin
Fox
Rohrer

15" Stainless Reactor with 1/3 lattice with H_3PO_4 + 5% HNO_3 in tubes (250 cc. per tube)

Tamped

Time	Sol Ht.	#1	#2	1/M₁	1/M₂	Remarks
1105	9.5	7.5, 7.0 } 7.0	2.5, 2.5 } 2.5			- Bkg { 7 8 9 empty
1115	16.9	13.5	5.0	.52	.5	5 empty
1122	20.3	36.5	17.0	.192	.147	
1129	21.1	64.0	30.0	.109	.083	

22.0 Critical with rod @ ~ 2.0 cm.
21.9 Sub-critical rod out

Critical 21.95 ± .05 cm.

Drainback:

1145

#2	5	4	9
23.9	16.5	9.6	
16.5	9.6	~2.0	D.V. + N 2.0 cm.
7.4 cm.	6.9 cm	7.6 cm	

21.95
1.14
Hc - 20.8+
Vc - 19.87 ✓
Mc - 2.38 ✓

4/14/50 — Exp #38.

Cronin, Fox, Henry, Rohrer

15" Stainless Reactor with 106 tubes with H_3PO_4 + 5% HNO_3 in tubes (250 cc. per tube)

Tamped.

Instruments as in Exp #32

1 Source

Sol. Lev. #2 #5 #7 #9

7.4 cm 6.9 cm 7.6 cm DV + 20 cm.

Time	Sol. Ht.	#1	#2	$1/m_1$	$1/m_2$	Remarks
1257	10.6 (bkg)	6.0, 6.0 } 6.0	2.5, 2.5 } 2.5			9 empty
	15.0 cm	—	—	—	—	7 empty
1313	20.5	11.0	4.0	.545	.625	
1318	25.1	23.0	8.5	.261	.294	
1322	26.0	—	—	—	—	5 empty
1325	28.1	53.0	24.0	.113	.104	
		50	20	.12	.125	rod North
		40		.15		n/cm.
1334	29.9	Sub-critical rod out				
	30.2	Critical with rod @ 26 cm.				
1338	30.1	Sub-critical rod out.				

Critical height on sight glass at 30.15 ± .05 cm.

− 1.14

H_c − 29.01

V_c − 17.43

M_c − 2.09

4/14/50 — Exp 435

Cronin
Fox
Henry
Rohrer

15" Stainless Reactor 10.6. tubes with H_3PO_4 + 6% HNO_3 in tubes (252 c.c per tube)

Untamped

Otherwise same as 434

	#1	#2	
Rhg as on Exp 432	25	14	@ 9.5 cm.

Time	Sol. Ht.	#1	#3	$1/M_1$	$1/M_2$	Remarks
	30.2	93.0	50.0	.27	.28	
	33.1	112.0	63.0	.223	.222	
~~36.~~						
	37.1	151.0	94.5	.165	.148	

Critical extrapolated to be between 45.5 & 48.2 cm.

Avg = 46.8 ± 1.3 cm.

Drum Bank -

#2	#5	#7	#9
37.1	26.0	14.5	3.5 cm + D.V.
26.0	14.5	3.5	
11.1 cm	11.5 cm.	11.0 cm	

46.8
1.14
H_c = 45.66
V_c = 27.39
M_c = 3.29 ✓

H/X = 144

1140
639
601 net area

Check List

	317	318	318	319	320	320	320A	321	322 A	322 B	323	324	325	327	328	329	330	331	332	333
Instruments																				
1. Personell																				
dosimeters and film badges	JF	JM	JC	HH	HH	FC	FC	FC	JF	FC	FC	HH	✓	JF	JF	←	←	FC	FC	
survey meter in control Rm.	JF	JM	FC	HH	FC	JF	DC	BH	✓		FC	FC	✓	RM	✓	←	←	FC	FC	
Process Monitor checked	RM	JF	FC	HH	RM	DC	FC	FC	JF	JF	←	FC	✓	RM	FC	←	←	FC	RM	
Catastophe badge	FC	JM	DC	HH	JF	JF	FC	DC	JM	JM	JF	FC	✓	FC	FC	←	←		FC	
2. Reactor System.																				
Trip points recorded	FC	FC	FC	HH	FC	FC	DC	DC	JM		DC	HH	✓	FC	JM	←	←	FC	FC	
Starting scales recorded	FC	FC	FC	HH	FC	FC	DC	DC	JM		DC	HH	✓	FC	JM	←	←	FC	FC	
Instruments respond to source	RM	JM	FC	FC	RM	DC	FC	FC	FC	JF	←	FC	✓	RM	FC	←	←	FC	FC	
Source in Operating position	JF	JM	FC	FC	FC	FC	FC	FC	JF	JM	FC	✓	✓	RM	FC	←	←	FC	FC	
All SOURCES Accounted for	DM	JM	FC	FC	RM	DC	RM	BH	JF		←	FC	✓	RM	FC	←	←	FC	FC	
Exp. No.'s on charts	JF	JM	JM	FC	FC	FC	FC	BH	FC		←	FC	✓	FC	JF	←	←	FC	FC	
Attic Fan																				
Reactor																				
Water in Tamper tank	—	FC	JF	FC	RM	JF	FC	BH	—	—	FC JF	✓	✓	FC	6" FC	←	←	JF	RM	
Top Tamper	—	JF	FC	FC	JF	JF	FC	FC	—	—	FC	✓	✓	FC	FC	←	←	JF	FC	
Smooth action Tamper Limit Switches Set.	—	JM	FC	FC	FC	JF	FC	FC	—	—	✓	✓	✓	FC	FC	←	←	JF	FC	
Safety Rod Set	JF	JM	FC	FC	FC	JM	FC	BH	JM		JF	JF	✓	RM	FC	←	←	JF	FC	
Control Rod zeroed	JF	JM	FC	JF	JF	JM	FC	FC	JM		FC	JF	✓	RM	JF	←	←	JF	FC	
Dump Valve Set	JF	FC	FC	FC	FC	FC	FC	FC	FC	✓	←	✓	✓	JF	JF	←	←	JF	FC	
Dump Pan taped up.	JF	JF	JF	FC	JF	FC	FC	←	JF	✓	←	✓	✓	JF	✓	←	←	JF	FC	
Check all Pulleys and wires	JF	JF	JF	JF	JF	JF	FC	←	JM	JF	←	✓	✓	JF	FC	←	←	JF	FC	
Solution																				
Solution Inventory in Reactor Ht.	FC	JM	JM	FC	FC	FC	←	←	JM	✓	←	?	9	FC	FC	←	←	FC	FC	
All valves inc. Dump Valve	JF	FC	FC	FC	FC	JF	FC	FC	JF	✓	←	FC	✓	✓	JF	←	←	JF	FC	
Pins in Cyl Valves	FC	FC	FC	FC	RM FC	JF	FC	FC BH	JM FC	JF FC	←	FC	✓	✓	JM JF	←	←	JF	RM	
Air Pressure	FC	JM	FC	FC	FC	JM	FC	FC	JF	JF	←	FC	✓	FC	JF	←	←	JF	RM	
Light on Feed Line	JF	JM	JF	FC	FC	JM	FC	FC	JF	JM	←	JF	✓	JF	JF	←	←	JF	RM	
Set Dump Spring	JF	FC	FC	FC	FC	FC	FC	FC			JF	FC	✓	JF	JM	←	←	JF	FC	
Final Check																				
Key to Rear Gate, Rear Gate Open.	JF	FC	DC	FC	RM	FC	RM	FC	FC		←	FC	✓	JF	JF	←	←	FC	RM	
Notify Guards, Check Personnel Red Light	FC	JF	FC	JF	FC	DC	RM	DC	JF		←	DC	✓	JF	JM	←	←	FC	FC	
Check For Leaks		JM	JF	FC	JF	FC	FC	FC	FC		←	✓	✓	JF	JF	←	←	FC	FC	

393 394 395 396 397 398 399 400 401 402 403 404 405 406 408 409 410 411

413 414 415 416 418 419 420 421 422 423 424 425 426 428 432 434

Air Regulator
4-7014

3S AL.

1.500" O.D. .035" wall
.049
.058