BOOK 112R

Notes:
on spine: "CEF 1"
some pages contain *very* light red writing, impossible to pick up on copier.

Blank pages: inside opposite page 1, 2, 4, 6, 28, 38, 56-58, 72-152, page opposite page 152.

pages 10, 12, 14, 16, 20, 36, 42, 44, 46, 48, & 50 each have 2 graphs attached
pages 18, 22, 26, 30, 32, 34, 52, 55, 60, 62, 64, 66, 69, & 70 each have 1 graph attached
pages 24 and 40 each have 3 graphs attached

Scanned by:
Sheila Finch
RSICC /Oak Ridge National Lab.
March 2, 2001

[redacted]

This notebook remains classified Confidential per conversation with L.R. Phillips, Y-12 Classification on 10-25-72 [illegible]

This notebook was apparently classified by a Y-12 Classification officer. We assume the ORNL Classification Officer was unavailable at the time classification was needed.

Classification changed to: remains CRD (level and category)

By authority of: CG-W-5 (classification guide)

F E Harrington 6/24/94

ADC or ADD signature (first reviewer) Date

ADD signature (final reviewer) Date

Classific
Classi
By a
By au
ADC
ADC
ADD
ADD

category)
guide)
er) Date
Date

RESTRICTED DATA
This document contains Restricted Data as defined in the Atomic Energy Act of 1954. Unauthorized disclosure subject to Administrative and Criminal Sanctions.

Classification changed to: U (level and category)

By authority of: CG-W-5 topic 931.2 (classification guide)

[illegible] 3/31/00

ADC or ADD signature (first reviewer) Date

David R Hamm 3/16/00

ADD signature (final reviewer) Date

Classific
By auth
ADC
ADD

RESTRICTED DATA
This docu... ...ricted Data as defined ... ...Energy Act of 1954. Unauthorized disclosure subject to Administrative and Criminal Sanctions.

RESTRICTED DATA
This docu... ...ricted Data as defined ... ...Energy Act of 1954. Unauthorized disclosure subject to Administrative and Criminal Sanctions.

[redacted]

[redacted]

UCN-6202
(3 8-78)

OAK RIDGE NATIONAL LABORATORY

OPERATED BY
UNION CARBIDE CORPORATION
NUCLEAR DIVISION

POST OFFICE BOX X
OAK RIDGE, TENNESSEE 37830

Transfer to: J. T. Thomas

assigned upon return of notebook from Y-12 Records Ctr for transmittal to J. T. Thomas

Confidential

ORNL Technical Notebook No. 6177

Assigned to: A. D. Callihan Date: 1-6-83

Division:

Dept./Section:

Program/Project: Experiments performed at Bldg 9213, Oak Ridge Critical Experiments Facility

Content

Research/Technical Description(s)/ Other Type Data	Inclusive Dates	Pages

[redacted]

[redacted]

1

Instrument Check on August 3 Source 10 mc ^{60}Co

950 V PM-1 Bal 8.47 Low Trip OK Trip OK

IC-1 3×10^{-10} Meter Trip Scram Table Fast Trip OK

IC-2 3×10^{-10} Meter Trip Rad. Monitor

IC-3 3×10^{-10} Calibration DWM A - OK

IC-4 1×10^{-9} Calibration DWM B - OK

C - OK

Bypass

Red Lite & Pers. Ck.

EXP #331

PuBe6 Source Placed on Fixed table

$\Delta\rho = 0.14$

Purpose: 8 units (16.2 kg ea) 2×2×2 compact unit array

4 units on each table - Reflected Bottom sides 5 3/4 in. Top Frontback 3 3/4 in.

Demonostrate operations technique to T. Hawk

Criticality should occur with ~1" table gap

9^{12} Start Assembly

$9^{25\frac{1}{2}}$ On Positive Period Table Ind. 0.874 in Rev. 11.4+

$9^{29\frac{1}{2}}$ Start to level.

9^{33} Rev 11.6 slightly POS

9^{35} 11.63 slightly neg

Manual Scrammed to shut down

DWM JTT

[redacted]

Expr. 332 8.3.72

Purpose: Repeat Expr 331 without external neutron source. Demonstrate operator technique to T. Hammrick.

9:50 AM Begin assembly.

10:01 AM Assembly at 11.6 Rev. log N about factor of 2 above backgrd.

10:02 " " 11.4 " assembly on pos. period.

table indicator .876"

10:07 Start to level. IC-1 10×10^{-11} IC-2 3×10^{-11}

10:09 assembly at 11.6 slightly super

10:10 " at 11.65 " sub. Ind ~.88 in

10:13 " at 11.6° k=1

Shut down - normal table reverse.

10:28 Secure control. JH DWM

Conclusion: It is not recommended to operate assemblies with spontaneous fission sources or other sources as small as 10^3 n/sec unless the criticality conditions have previously been determined with an experiment utilizing a larger source.

CONCRETE REFLECTED

ARRAY EXPERIMENTS (see p 54-55 for Keno description)

Chamber locations CLOCK ~4960

IC-1 Under Table

IC-2 On top of shelves on fixed table (often U placement)

IC-3 Southeast corner Fixed Table } three 16 in concrete

IC-4 South center of assembly, Fixed Table

8 in cells – 4 x 4 x 4 array

Stacked 32 x ~~64~~ x 12 in base reflector slab,

Movable & fixed tables

Stacked 16 in thick side reflectors.

Instrument Check on Oct 16, 72 Source 10 mc ^{60}Co

8.20 – 8.70 not stable with time

PM-1 _____ Low Trip OK Hi Trip OK

IC-1	3×10^{-10}	Meter Trip	Scram Table	Fast Trip	OK
IC-2	3×10^{-10}	Meter Trip	OK	Rad. Mon.	Alarm
IC-3	Resp OK	Calibration	Dwn	A	OK
IC-4	Resp OK	Calibration	Dwn	B	OK
Pers & Rad Mo	OK	Bypass OK		C	OK
		Δρ OK			

DWM JJL

EXP # 333

Multiplication & Inst Resp. Check with 32 units

16 on each table, 8 on each shelf – 2 layers

No top reflector, Pu Be 6 on top of 3rd shelf on fixed table.

Subcritical when tables closed

IC-2 0.065 to 0.12 on 3×10^{-11}

M = ~2

EXP #334

Multiplication & Inst Resp check with 48 units
4x4x3 array of 8 in cells, U blocks
on .032 Al sheet on bottom reflector
Block spacing on shelves set by scribe marks
No Top Reflector, Pu Be #6 source on 4th layer

	IC-1	2	3	4
Separated	$.02 \times 3 \times 10^{-11}$	$.05 \times 3 \times 10^{-11}$	—	8×10^{-13}
Closed	.02 "	.09	1.4×10^{-12}	1.1×10^{-12}

Mult. less than 2
Inst Resp OK

EXP #335

Multiplication and Inst Resp. check with 64 units
4x4x4 Array — with 2 in top concrete
reflector. Slabs are cracked and not
designed for loads -- cannot add concrete
block on top for thicker concrete reflector.
Pu Be-6 placed manually on 3rd shelf
center of fuel table. IC-2 on top of 2" concrete.

		IC-1	IC-2	IC-3	IC-4
1^{00} P	Sep	$.02 \times 3 \times 10^{-11}$	$.045 \times 3 \times 10^{-11}$	2.0×10^{-12}	$.95 \times 10^{-12}$
1^{21}	Closed	.18 "	$.07 \times 10 \times 10^{-11}$	1.6×10^{-11}	$.65 \times 10^{-11}$

M = ~ 8 or 9.

3.250 → 8.255 length

68.145 area

If Vol = 174.37 → 2.558 cm thick

Total weight 26 180 g

av wt 3 272.5 g

@18.77 vol 174.347 cc

If 2.54 cm thick Area 68.64

5.285 cm

EXP # 336

4X4 x4 Array with >6 in CH_2 top reflector
M-230 Source mounted ~~in~~ Drive on Fixed Table.

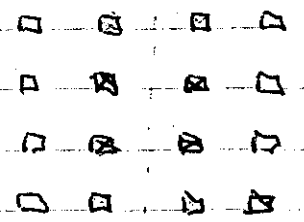
2^{20} Subcritical, but at high multiplication.

2^{22} Raise Power with Source | IC-3 = 2.6×10^{-10}
Promp Jump on Source Jerk, | Spr $6.0 \times 10^{-}$ M = 46.7
was a factor of 5-10.

337

ADD 4ea 1 x 3 1/4 x 3 1/4 on top of 4 central units top row - 2 on each table.

	IC	
Tables Closed	1	$.22 \times 3 \times 10^{-10}$
Max Power Source In.	2	$.465 \times 3 \times 10^{-10}$
	3	5.0×10^{-10}
	4	1.8×10^{-10}



2^{50} Source Jerk 5.0/20 = 2.5

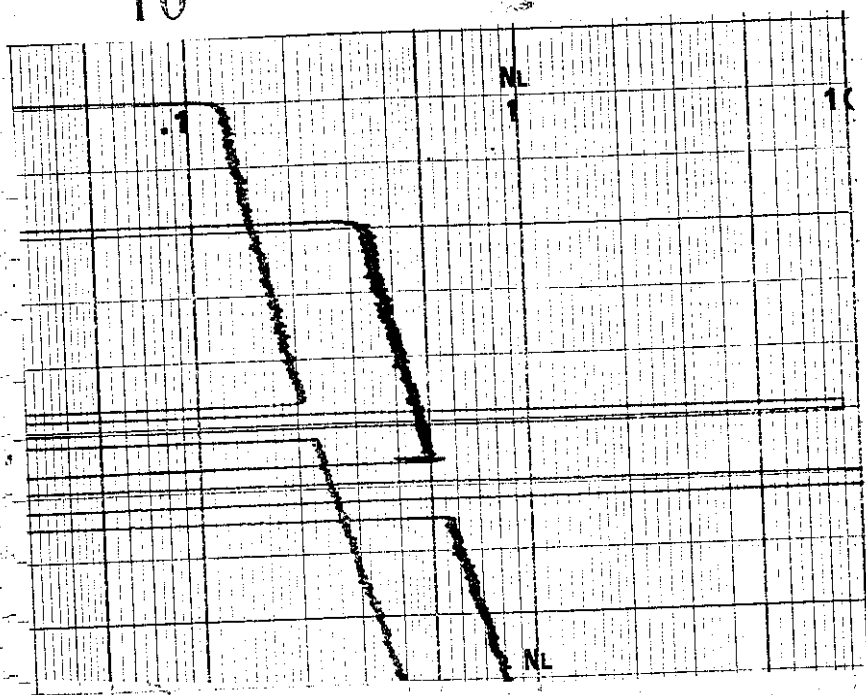
2^{54} Shut Down.

338

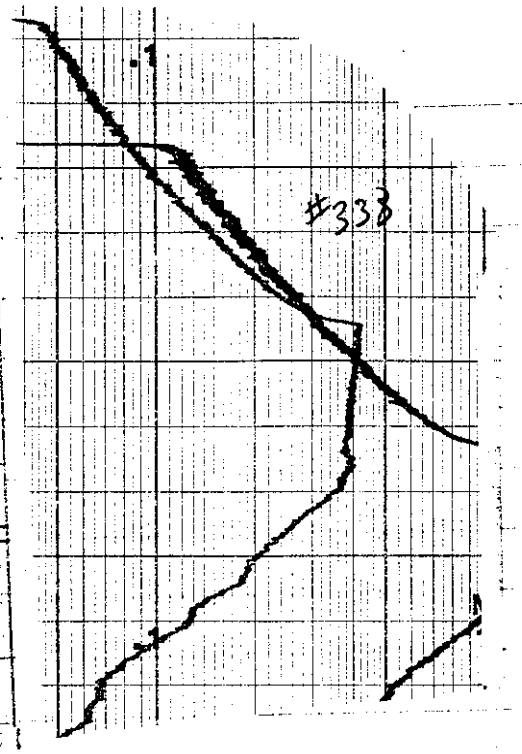
ADD 4ea 1x3 1/4 x 3 1/4 on top of 4 units at plane of separation, see red X on above sketch
total of 8ea 1x3 1/4x 3 1/4. all but #23

~~Table closed - slightly super [illegible]~~
~~Quest [illegible] high enough to be above~~
~~Spont [illegible]~~

10



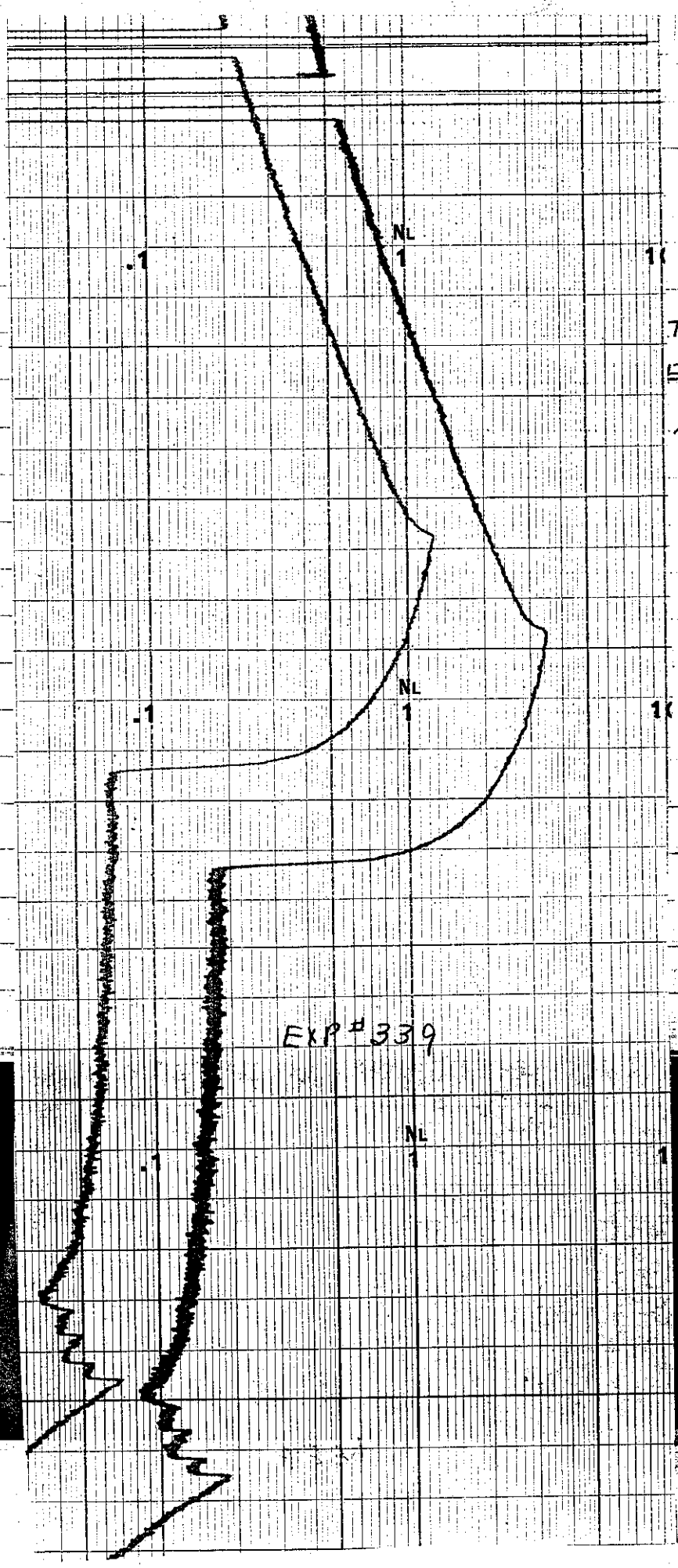
#339

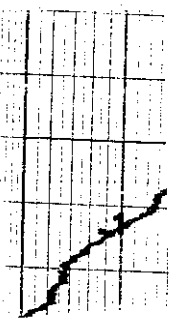


8^{30} AM 10-17-72

Table not resettable.

ERR repaired wire in scram panel on Inst. Trip Bus. Dwm





8^{30} AM

Table not re

ERR repo

scram po

Bus.

#338 (Cont.)

3^{20} Start ~~[illegible]~~ Source - ~~[illegible]~~ Power to 1.2×10^{-9}

3^{31} Near Crit Remove source, neg period near 80 sec.
Prompt jump 1.15 → 0.8, tis near critical!

#339

Add 8 ea 1/8 x 3 1/4 x 3 1/4 now 8 ea 1 1/8 x 3 1/4 x 3 1/4
on top of 8 units on top shelf at Midplane

3^{50} Start Assembly

4^{00} Slightly super @ IC-3 ~ 1.7×10^{-10}, Insert source
Raise IC-3 to 3.4×10^{-9}, remove source

Instrument Check on Neg Period 10-17-72 Source — Shut Down 10 mc 60 Co.

PM-1		Low Trip	OK	Trip	OK
IC-1	3×10^{-10}	Meter Trip	OK	Fast Trip	Scram Table
IC-2	3×10^{-10}	Meter Trip	OK		Rad Mon alar
IC-3	1.5×10^{-9}	Calibration	DWM		A OK
IC-4	1×10^{-9}	Calibration	DWM		B OK
					C OK

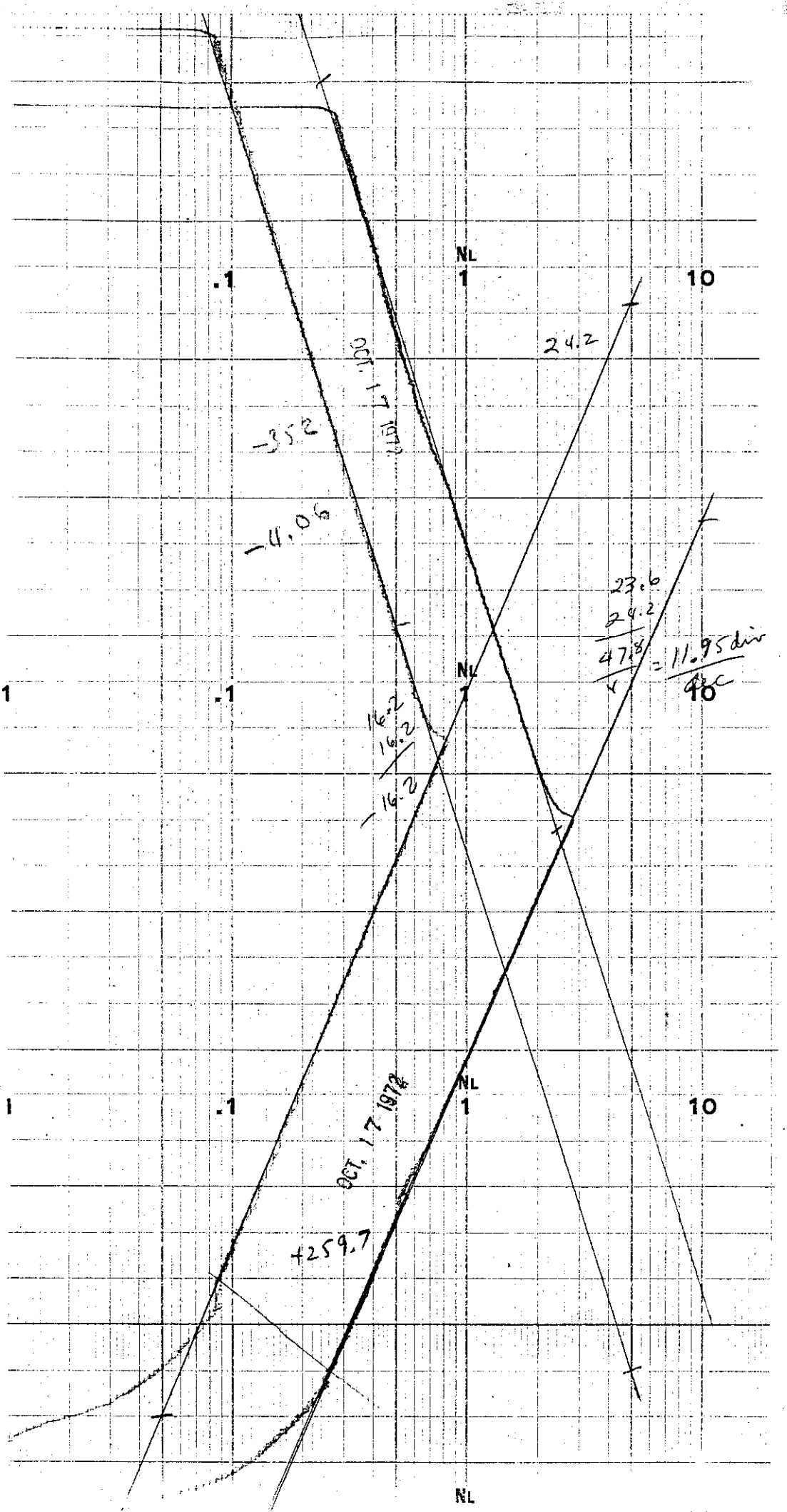
DWM

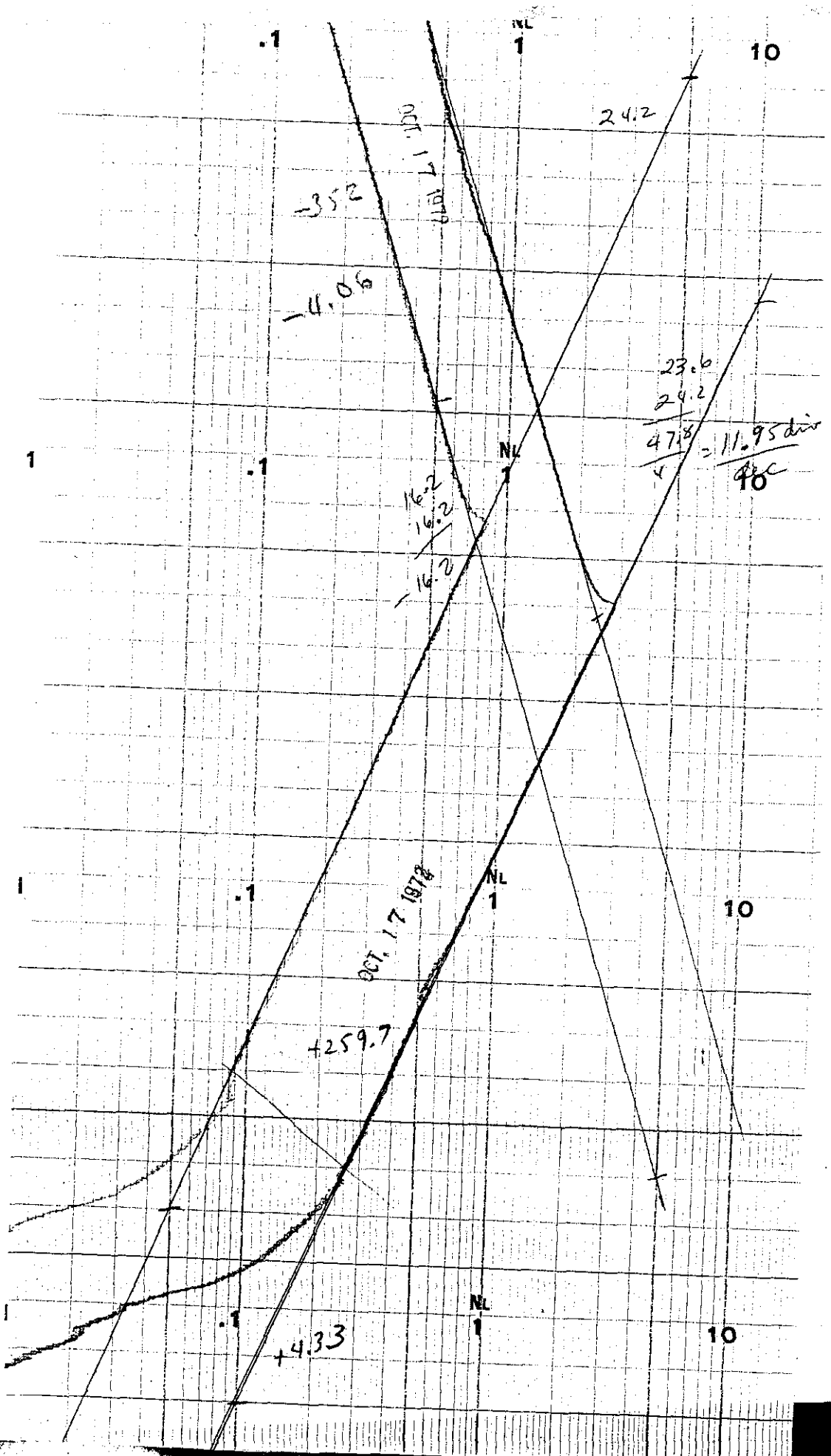
JJL

EXP #340

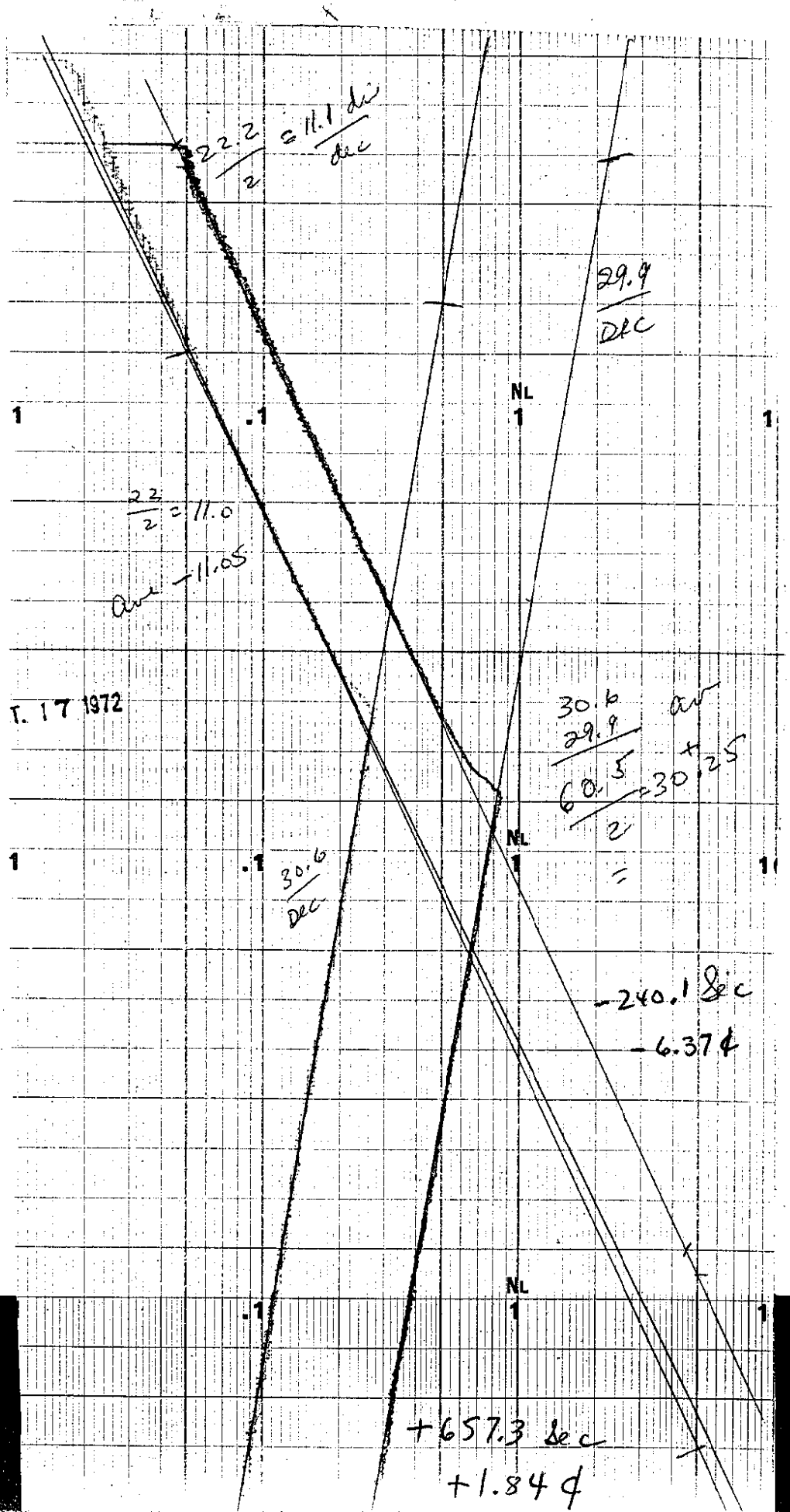
Add 4 ea 1/8 x 3 1/4 x 3 1/4 to Movable Table units
now 4 ea 1 1/4 x 3 1/4 x 3 1/4
and 4 ea 1 1/8 x 3 1/4 x 3 1/4 on fixed table

Moved IC-3 and IC-4 farther from assembly —
to floor under neath. ~10 x less sensitive

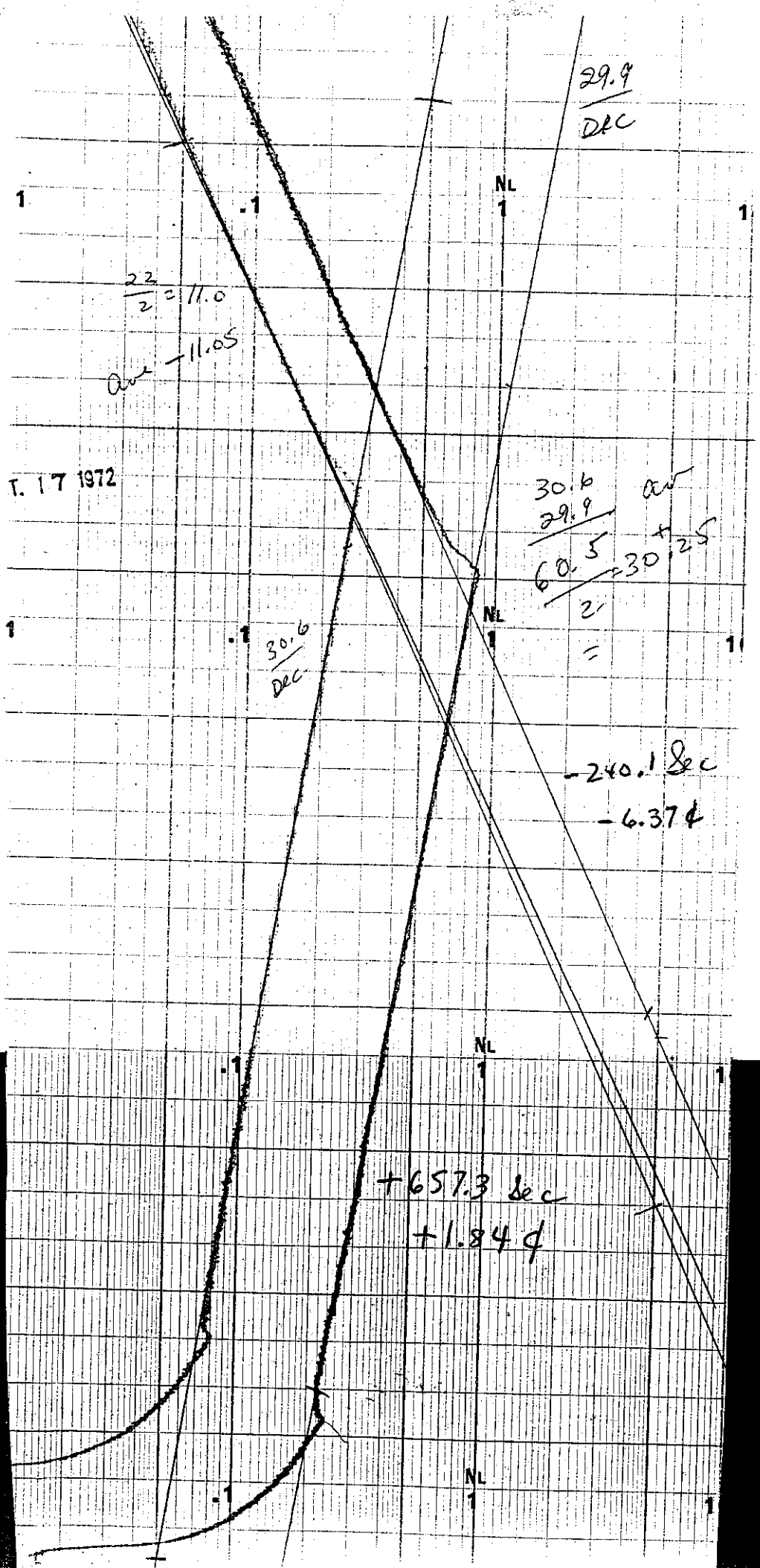

NL
.1
1
10
24.2
OCT. 17 1972
-35.2
-4.06
23.6
24.2
47.8
4
= 11.95 div/sec
16.2
16.2
16.2
OCT. 17 1972
+259.7



.1
NL
1
10
24.2
OCT. 17 1979
-352
-4.06
23.6
24.2
47.8
4
= 11.95 div
sec
16.2
16.2
-16.2
OCT. 17 1978
+259.7
+4.33



22.2/2 = 11.1 di/dec
29.9/Dec
NL
1
.1
1
22/2 = 11.0
ave -11.05
T. 17 1972
30.6
29.9
ave
60.5/2 = 30.25
30.6/Dec
-240.1 Sec
-6.37¢
+657.3 Sec
+1.84¢



29.9
DEC
NL
1
.1
1
22/2 = 11.0
ave -11.05
T. 17 1972
30.6
29.9
ave
60.5/2 = 30.25
30.6
DEC
-240.1 Sec
-6.37¢
+657.3 Sec
+1.84¢

Assembled tables – with source in power to 2.4×10^{-10} on IC-3 (corresponds to previous value of $\sim 2.4 \times 10^{-9}$)

On Positive Period Table Closed 657.3 sec → 1.84 ¢

Tables separated 2.0 Rev for Neg Period −240.1 sec → −6.37 ¢

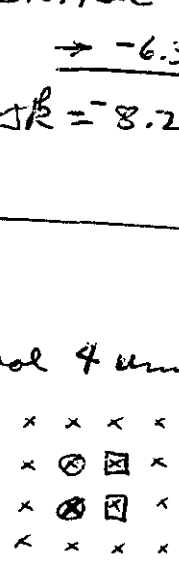
$\Delta k = -8.21$ ¢

EXP. #341

Moved All extra 3"/4 × 3"/4 pieces to Control 4 units

2 ea Mov. Table 2"/2 × 3"/4 × 3"/4, ○

2 ea Fix. Table 2"/4 × 3"/4 × 3"/4, □



Assemble to measure pos. period and reactivity change

+259.7 sec → +4.33 ¢

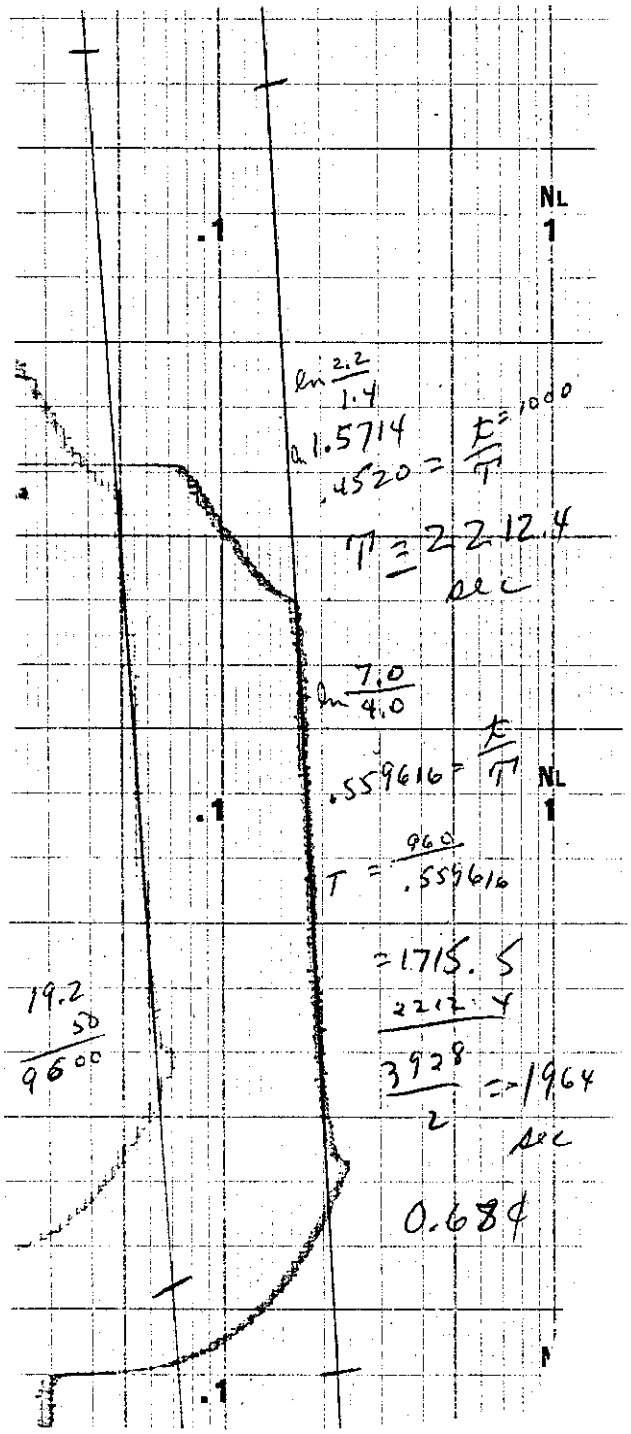
Set Tables to 2.0 Rev for Neg Period −352.0 sec −4.06 ¢

−8.39 ¢

Δk for material Arr. Change 4.33

1.84

2.49 ¢



all ¼ pieces exc # 50

6339 g

av wt 792.375 g

Vol 42.215

$\frac{1}{68.145}$ Thick 0.6195 cm

av. ⅛ pieces 417.5 g

22.243 cm^3

Average thickness .3264 cm ⅛

.6195 ½

.9459 3/8

.3264 ⅛

1.2723 ½

2.558 → 1"

3.8303 → 1½

all 4 pieces exc # 50

6339 g

av wt 792.375 g

Vol 42.215

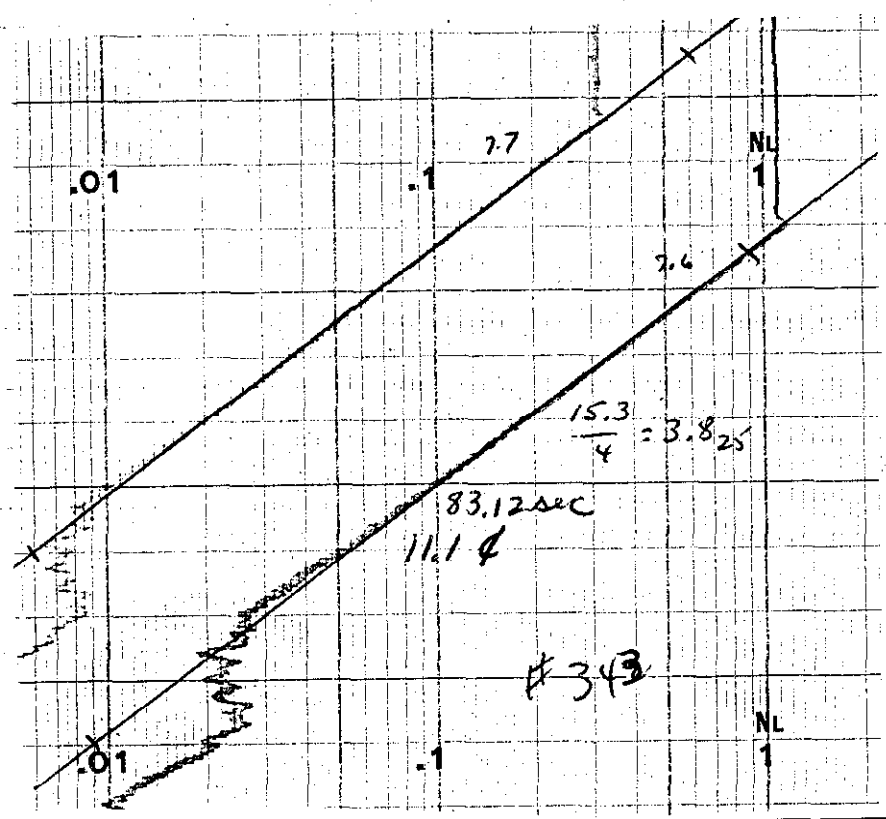
$\frac{1}{68.145}$ Thick 0.6195 cm

av - $\frac{1}{8}$ pieces 417.5 g

22.243 cm^3

Average thickness .3264 cm 1/8

.6195	1/4
.9459	3/8
.3264	1/8
1.2723	1/2
2.558	→ 1"
3.8303	→ 1 1/2



EXP # 342

Change top Arrangement to $1\frac{1}{4} \times 3\frac{1}{4} \times 3\frac{1}{4}$
on 8 ea edge locations all identical
(Later will evaluate worth of $1\frac{1}{4} \times 3\frac{1}{4} \times 3\frac{1}{4}$.)

Measure excess reactivity

Start Assembly Source, Δp, Bypass, Red Lite

IC-3 = 3×10^{-11} and rising
probably subcriti w. source

1[13] Insert Source M-230 – to raise power to IC-3 2.4×10^{-10}
Remove Source " Neg Period – 1964 sec
– 0.68¢

Preliminary calibration of Digital Position Indicators

	DPI W		DPI E	
Closed	.070		0.102	
2. Rev	.138		.168	
2 Rev	.137		.167	
2 Rev	.136	.066	.166	.064

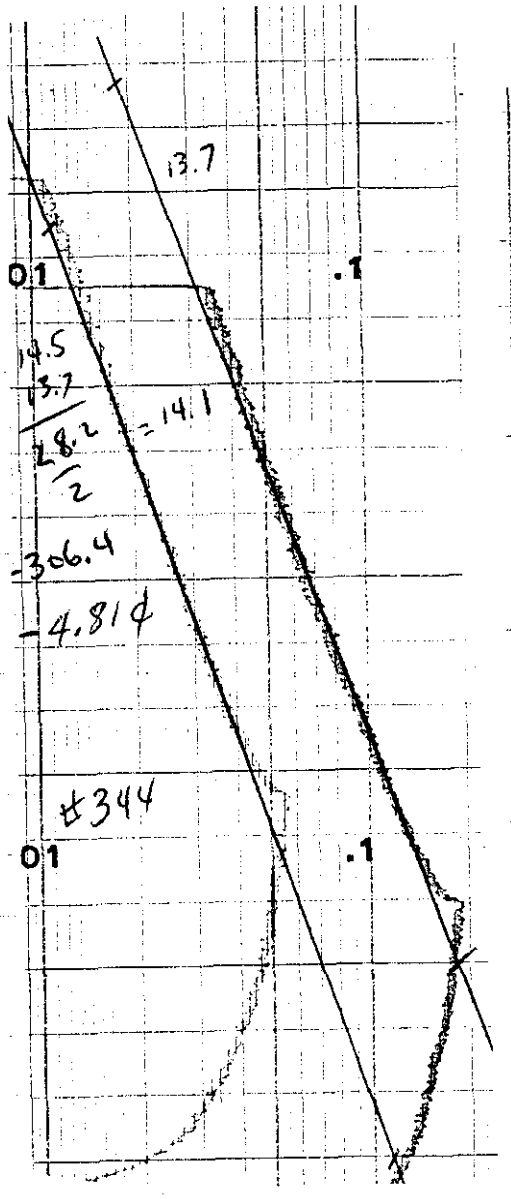
Change zero

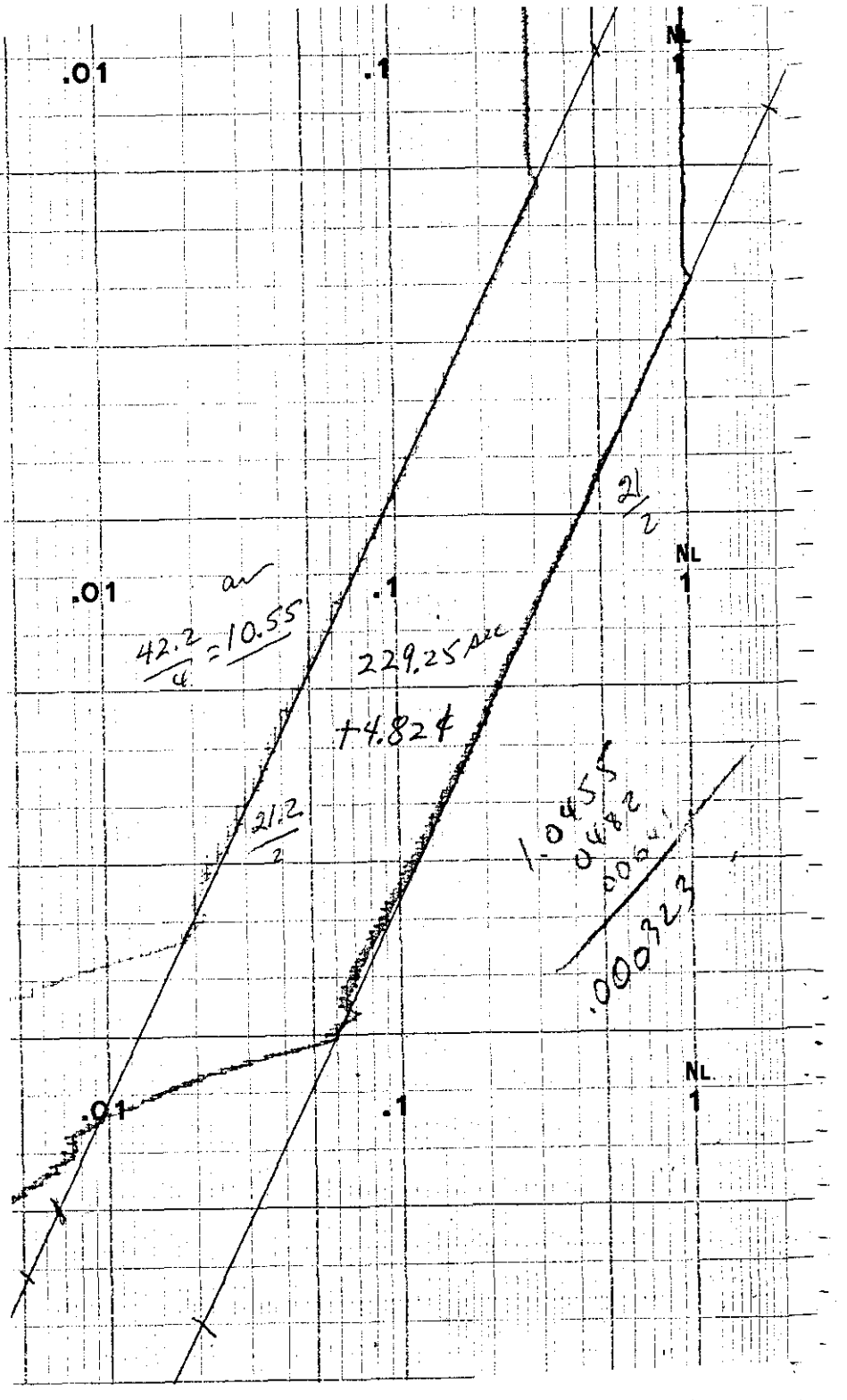
EXP # 343

Add 8 ea $\frac{1}{8} \times 3\frac{1}{4} \times 3\frac{1}{4}$ now

1[45]	On Pos Period	.089	.103	+83.1 sec
47	Start to level			+ 11.1¢
56	Level	.178	.189	– .7
				11.8¢

for 8 ea $\frac{1}{8}$


13.7
.01
.1
14.5
13.7
28.2/2 = 14.1
-306.4
-4.814
#344
.01
.1


.01
.1
NL
1
21/2
.01
.1
NL
1
or
42.2/4 = 10.55
229.25 sec
+4.824
21.2/2
1.0455
.0482
.00823
.01
.1
NL
1

EXP # 344

Remove 1 ea 1 3/8 x 3 1/4 x 3 1/4

7 ea remain.

Measure Reactivity change for

Raise Power w. Source 1.9×10^{-10} W .089

Remove Source for Neg Period - E .103

— 306.4 sec — 4.81 ¢

+ 11.1

Each 1 3/8 x 3 1/4 x 3 1/4 — 15.9 ¢

8

4 x 4 x 4 array is then 127.2 ¢

Subcritical!!!! 11.1

— 115.1 ¢

EXP # 345

Add 7 ea 1/8 x 3 1/4 x 3 1/4

Now 7 ea 1 1/2 x 3 1/4 x 3 1/4

Measure excess reactivity

Assemble to DPI W 0.090 DPI E 0.102

2 50 pm On Positive Period + 229.25 sec

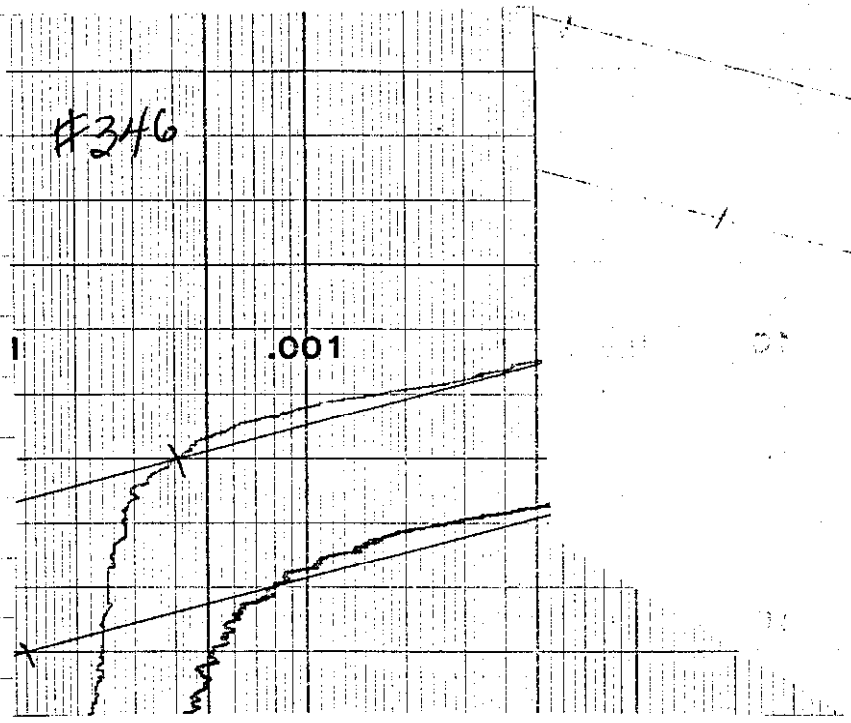
On + 4.82 ¢

3 01 pm Start to Level

Level .133 .142

.043 .040

Average .042



1.0605
2254
00641

.00153
00032

.00121
x8

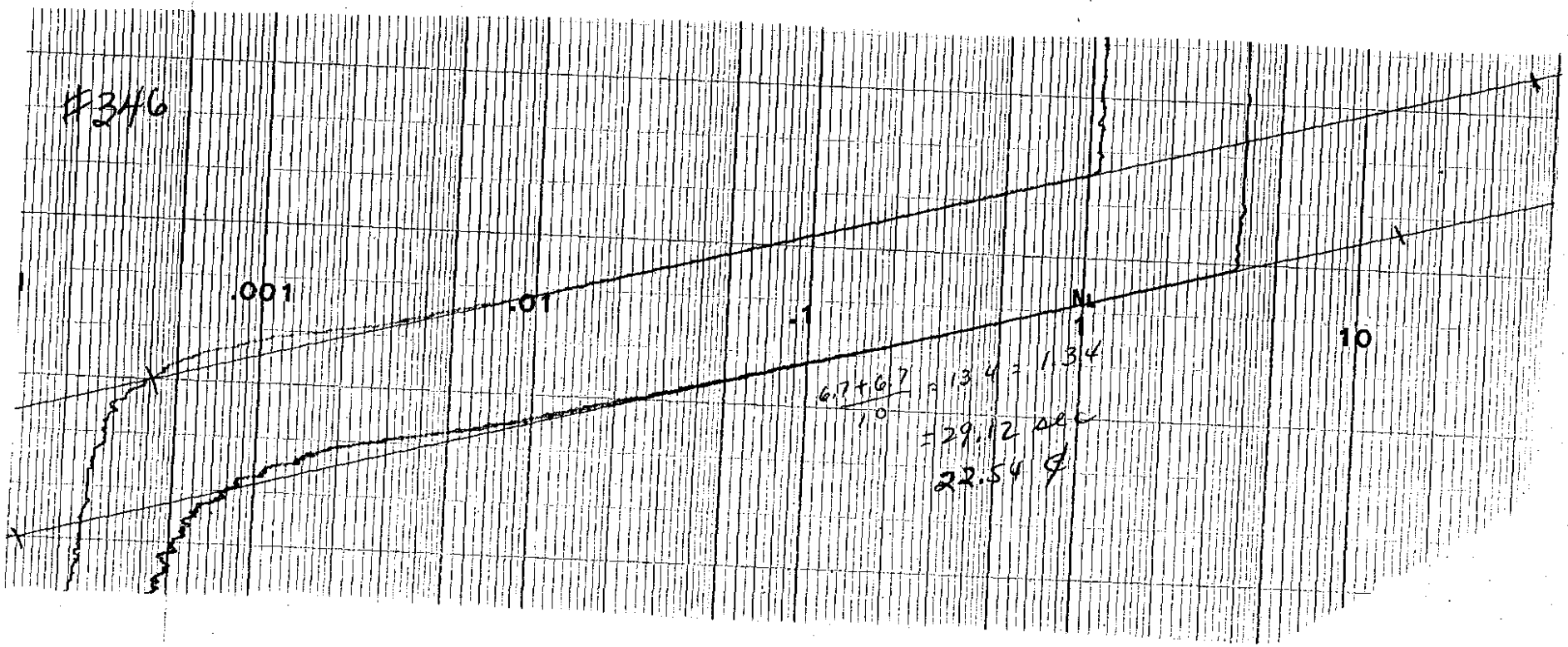
.00968

1.00153
00968

.99185

[redacted]

18



1.0605
2254
00641
.00153
000?
.00

#346

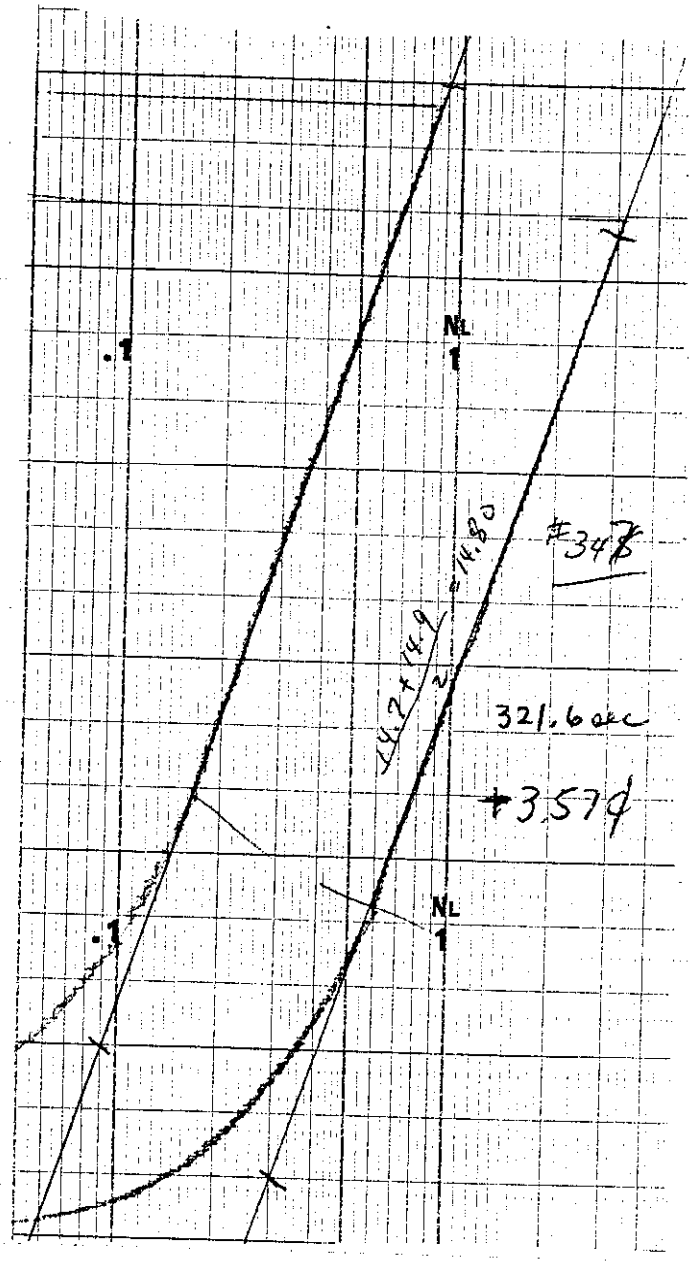
Added 1 1/2 x 3 1/4 x 3 1/4 to assembly unit
now 8 ea 1 1/2 x 3 1/4 x 3 1/4 on assembly Top layer
see pattern for 342.

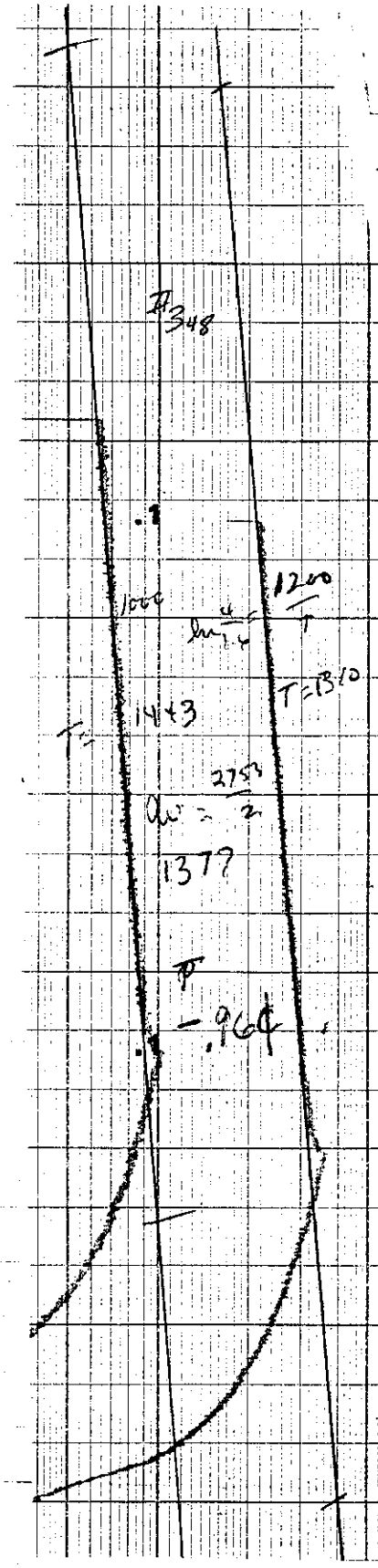
Measure excess reactivity. – No Ext. Source Startup.

			DPIW	DPIE
~3:27	On Pos Period	29.12 sec = 22.54¢		
3:30	Start to level		0.090	0.102
3:40	Level		0.260	0.270
41	Shut Down		Δ .170	Δ = .168

Worth of 1 1/2 x 3 1/4 x 3 1/4 = 22.54
4.82
17.7 ¢
8
141.6
22.5
4 x 4 x 4 array 119.1 subcrit

		8 ea 1 1/4	-0.7 ¢
7 ea 1 3/8	-4.8 ¢	8 ea 1 3/8	+11.1
7 ea 1 1/2	+4.8	8 ea 1 1/2	+22.5
7 ea 1/8	9.63 or 1.38 ea	8 ea 1/8	11.8 or 1.475 ea
		8 ea 1/8	11.4 or 1.425 ea
1 ea 1 3/8	15.9	1 ea 1 1/2	17.7
	+1.4		
	17.3 vs 17.7		


.1
NL
1
#348
14.2+14.9 / 2 = 14.80
321.6 sec
+3.57¢
.1
NL
1


#348
.1
1000
1200
T=1310
1443
1377
-.96¢
.1

Instrument Check on 10/19/72 Source 10 mc ^{60}Co DWM ADC

PM-1		Low Trip	OK	Trip	OK
IC-1	3×10^{-10}	Meter Trip	OK	Fast Trip	OK
IC-2	3×10^{-10}	Meter Trip	Scram	Radiation Mon Alarm	ΔP OK
IC-3	Res OK	Calibration	DWM	A OK	Bypass OK
IC-4	" OK	Calibration	DWM	B OK	Reahite OK
				C OK	

EXP # 347

Repeat EXP # 345 7ea 1½ x 3¼ x 3¼

10 24 Tables Closed — Insert Source to Raise power
DPIW.090
E.102 from 5×10^{-12} to $\sim5\times10^{-10}$ on IC-3

N ⊗ x | x ⊗ S

10 29 Remove Source for Pos Period

10 38 Shut Down, Manual Scram.

Exp # 348

Measure React for 3ea 3ea 3 x 3¼ x 3¼ □

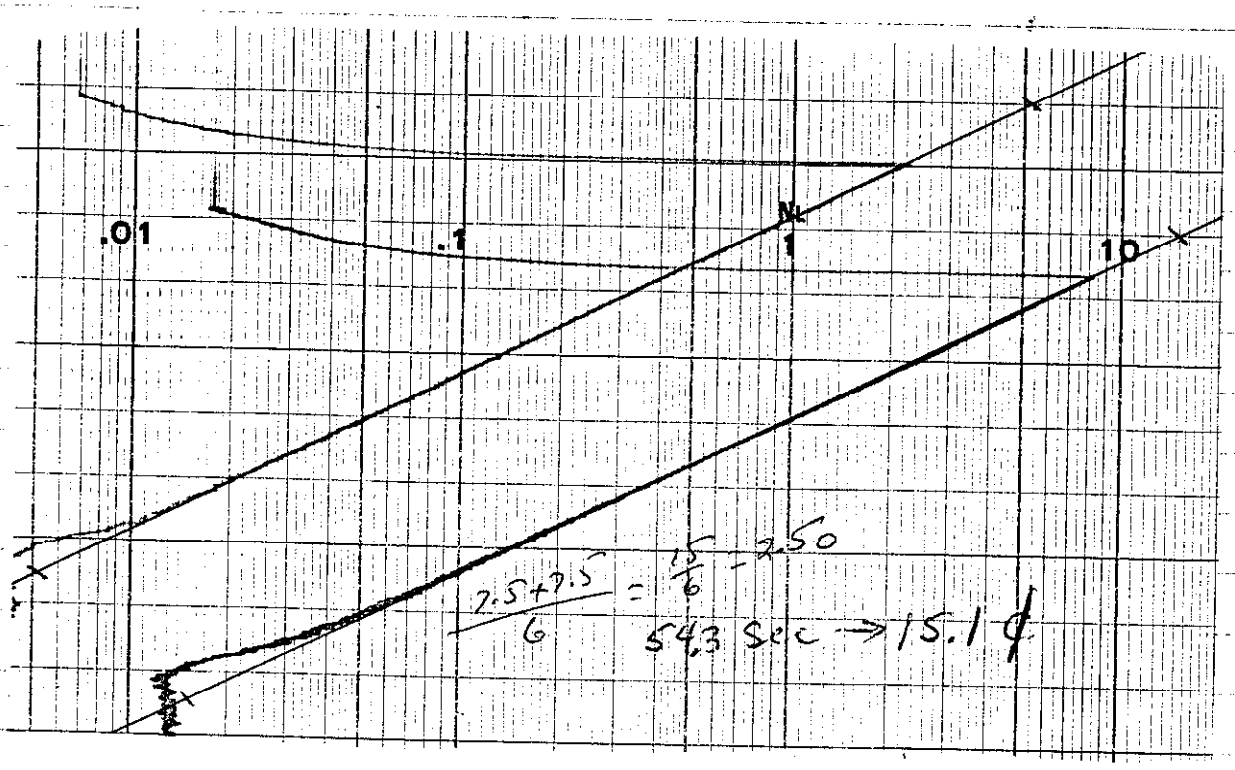
Double stacks (1½ to 3 in high) 1ea 1½ x 3¼ x 3¼ ○

added to 3 units.

10 53 Tables Closed DPIW.088 E.102

10 58 Remove Source for Neg Period! N

11 02 Shut Down, Manual Scram

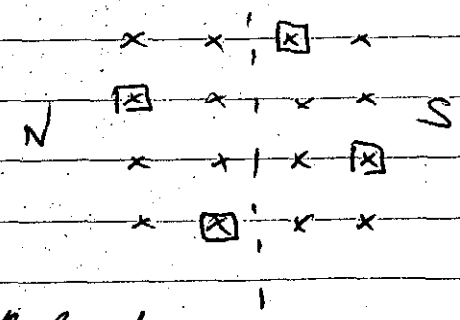


1054
.151
.0661
.00102

Exp # 349 DWM ADC

Add 1½ x 3¼ x 3¼ to unit hovering 1½ x 3¼ x 3¼

Now 4ea 3 x 3¼ x 3¼



11 18 Start Assembly

11 25½ Tables Closed W .088 E .103

26½ Remove Source for Pos. Period.

27 Pos Period to great to measure about ln 1

Separate tables to reduce power

32½ Tables Closed for Pos Period W .088 E .103

IC-2 scrammed at 3x10⁻⁸ ~120% of Fuel Scale.

(Inst. Shut Down)

Intentional!

7ea 1½ x 3¼ x 3¼ = 3.6 ¢ > 4.6 for moving 3 ea

3ea 3 + 1ea ½ −1.0 ~~> 11.5 ¢ for 1½ x on top~~

4ea → 3 x 3¼ x 3¼ 15.1 ¢ 16.1 ¢ for 1½ on top of 1½ x

~~3ea 3" + 1ea~~ ~~[illegible]~~ vs

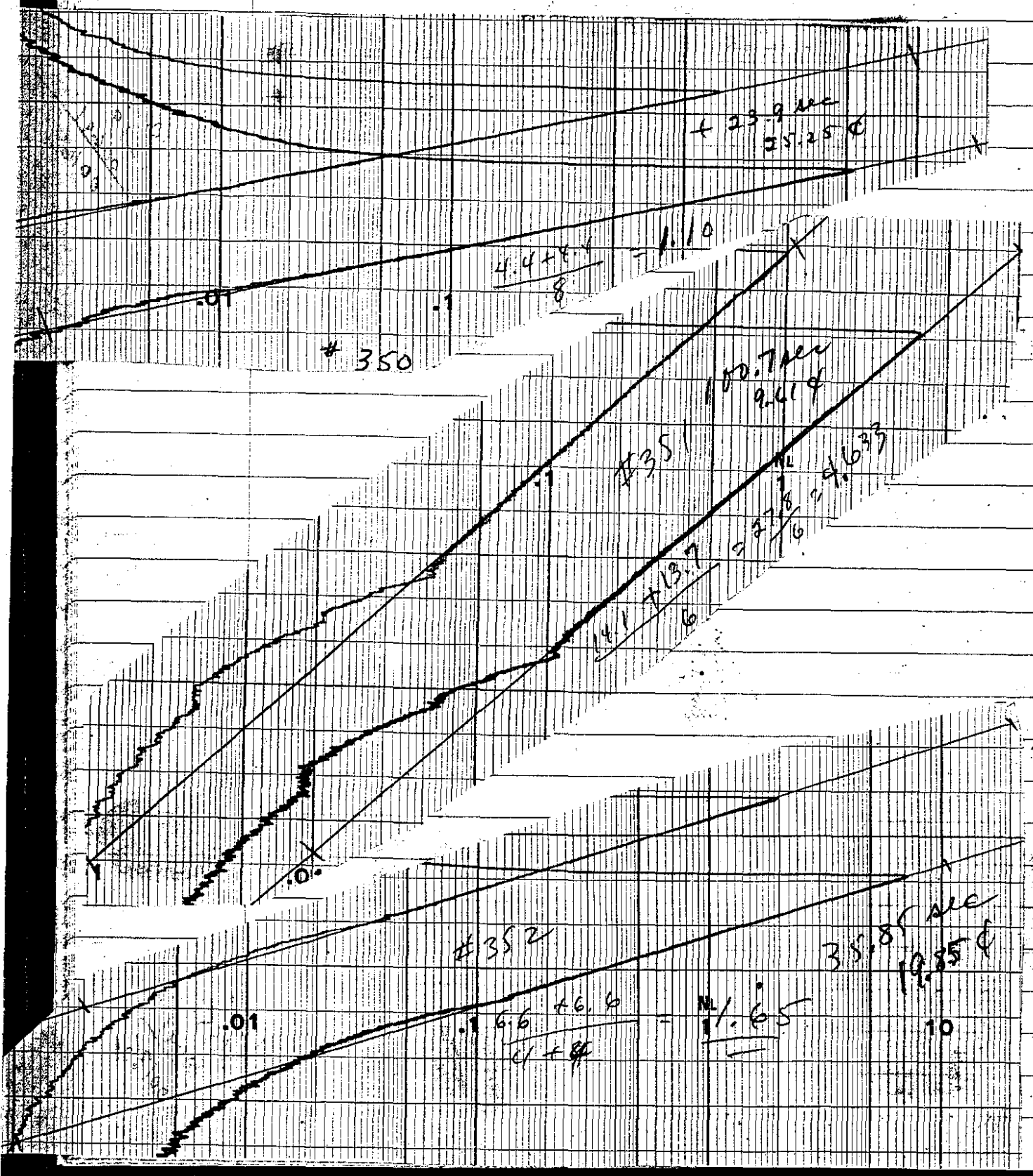
17.7 ¢ for 1½ on top of 3¾ cube!

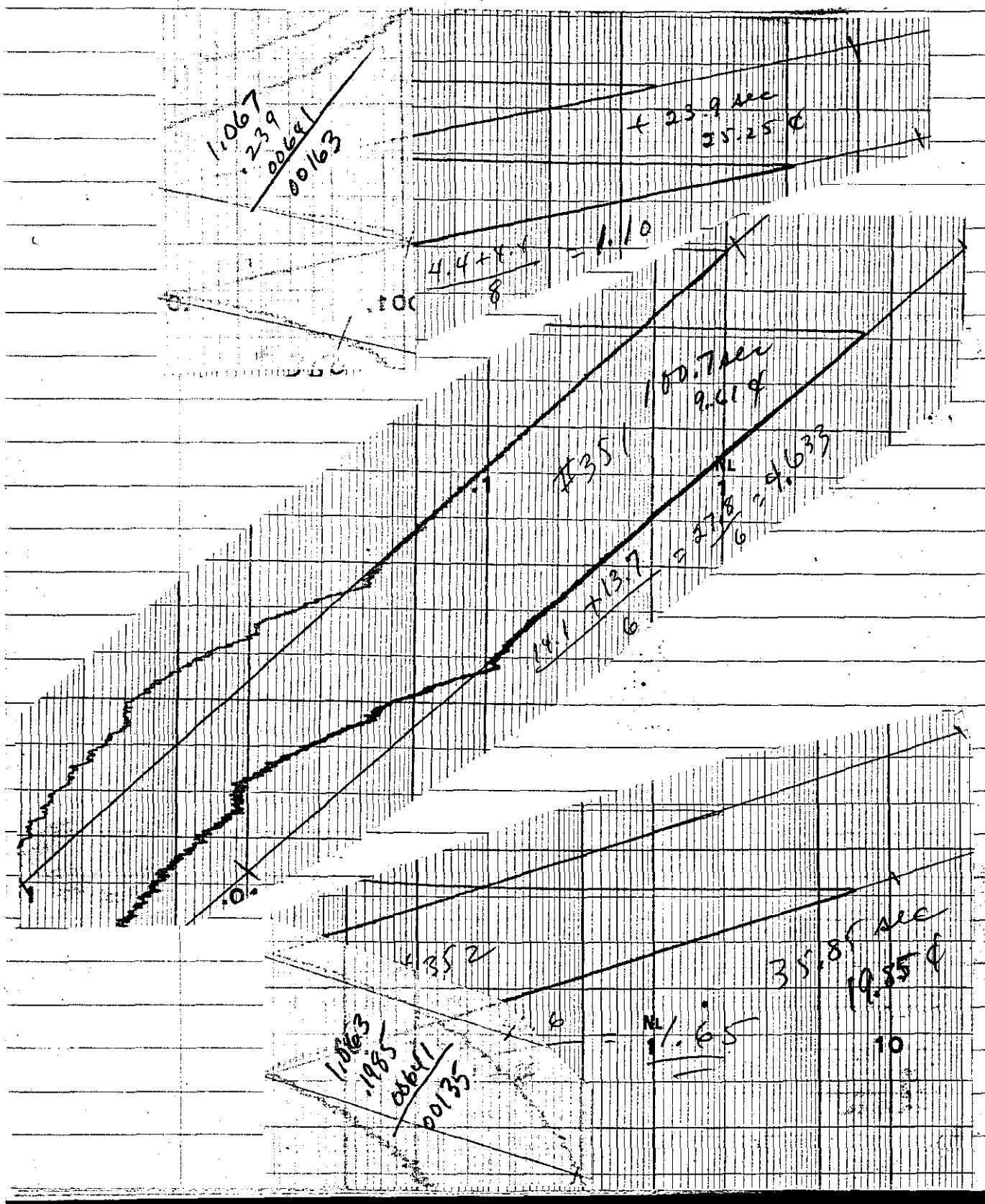
Moving 3ea 1½ therefore

worth −1.8 x 3 = ~~[illegible]~~ $ 5.4

compare to 4.6 ¢ measured

2


+ 23.9 sec
25.25 ¢
4.4 + 4.4 / 8 = 1.10
.01
.1
350
100.7 sec
9.61 ¢
#351
NL
1
14.1 + 13.7 / 6 = 27.8 / 6 = 4.633
.1
.01
#352
35.85 sec
19.85 ¢
6.6 + 6.6 / 4 + 4 = 1.65
NL
1
.01
.1
10



N. Source
Start up

1
~1

1 30
1 43
1 47

Cod 1½

2
2

Dwg 25
EBJ

63 ea 3¾ x 3¾ x 3¾ EXP # 350

Remove 1 ea 3¾ x 3¾ x 3¾ O Top Row South

No Source Start up

Add 2 ea 3 x 3¼ x 3¼

Now 6 ea 3 x 3¼ x 3¼ □

Measure React Change + 25.25¢ (N) (S)

1 12 Start Assembly DPI W 0.087

~1 23 On Pos Period E 0.103

25 Shut Down

3.5
201.30
119.1
82.2 worthy block

63 Blocks EXP # 351

Remove 1½ x 3¼ x 3¼ from 1 unit

Now 1 ea 1½ x 3¼ x 3¼ } on 6 units
5 ea 3 x 3¼ x 3¼

Measure React Change for 1½ x 3¼ x 3¼.

1 36 Start Assembly

1 43 On Pos Period Source Out DPI W .089 E .102

1 47½ Shut Down Δk for 1½ → 25.25
9.61
15.6 ¢

EXP # 352

Move Block Vacancy to interior 4. at ●

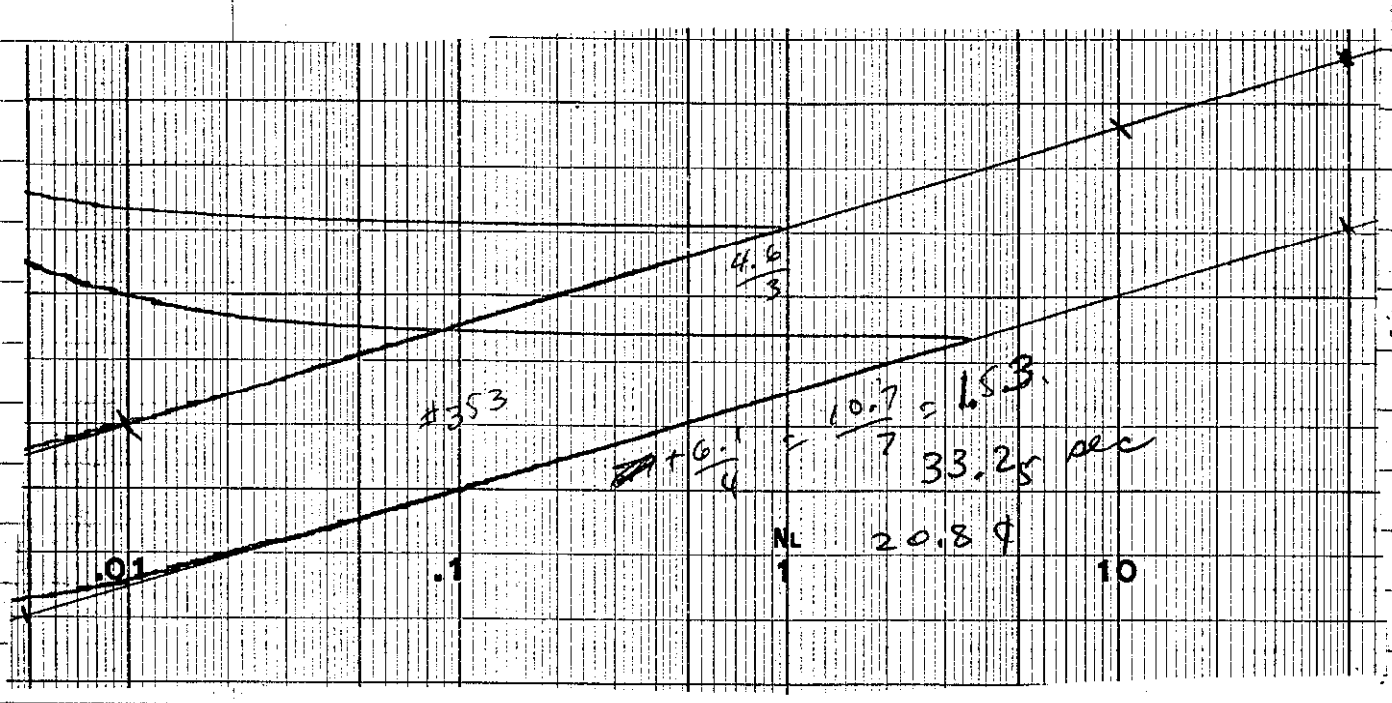
add 1½ x Now 6 ea 3 x 3¼ x 3¼

1 58 Start Assembly

2 08+ On Pos Per.

2 11 Shut Down

Δk for moving hole 25.25
19.85
5.4 ¢



1.063
.208
.00642
.00142

EXP # 353

Move Block Vacancy to new location

~~2^{20}~~ Measure React Change +20.8¢ x [x] [x] x

2^{20} Start assembly 089 [x] x x x

2^{28} On Pos. Period 103 [x] x ● [x]

2^{31} Shut Down x [x] x x

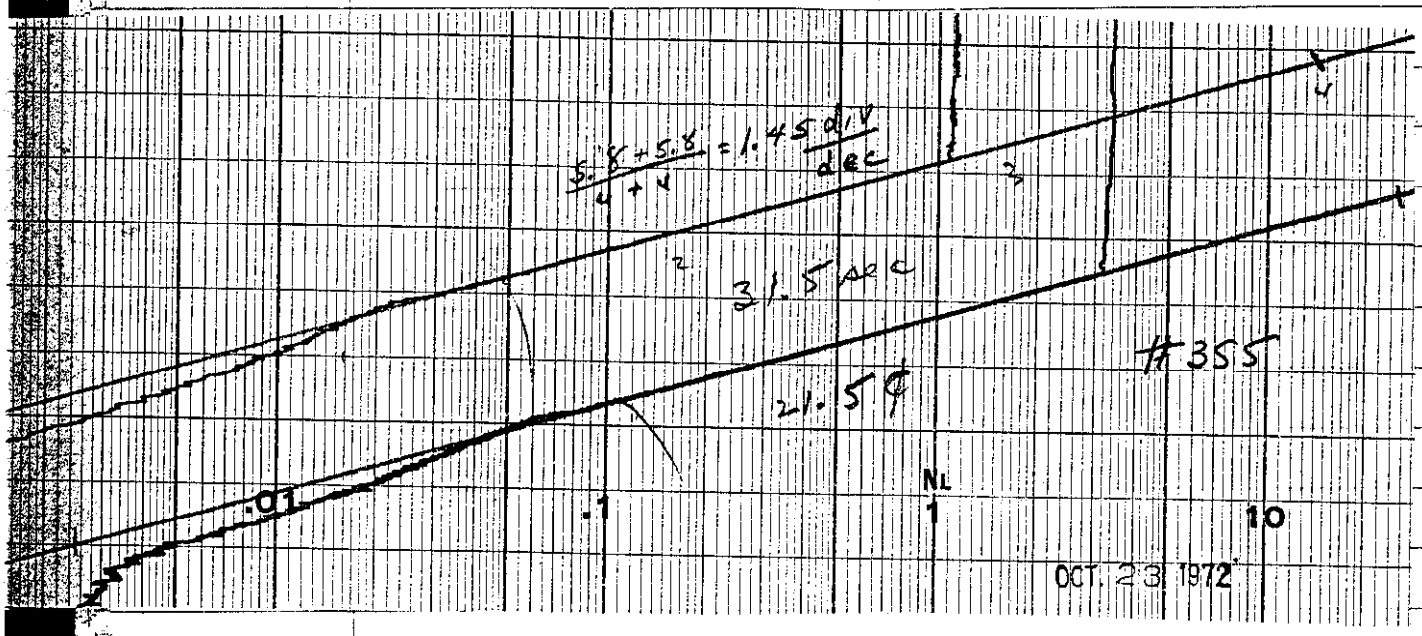
Δk for moving hole

+ 1.0 ¢

OCTOBER 23, 1972

ERR — Recalibrated DPI W & E with Dial Indicator. Reset zero to 0.100 and 0.100. Linearity is 1 to 2 mils in 1.9 in.

Zero 0.100 with tables loaded with concrete reflector, CH_2 TiO_2 reflector and 48 of the 64 $3\frac{3}{4} \times 3\frac{3}{4} \times 3\frac{3}{4}$ units!



$\frac{5.8+5.8}{4+4} = 1.45 \frac{div}{dec}$
31.5 sec
21.5 ¢
#355
.01
.1
NL
1
10
OCT. 23 1972

OCT. 23 1972

Instrument Check on Oct 23, 72 Source 10 mr ^{60}Co

Bal
8.33

PM-1 950 V Low Trip Scram Table Trip OK

IC-1 3×10^{-10} Meter Trip OK Fast Trip OK

IC-2 3×10^{-10} Meter Trip OK Red Non Alar

IC-3 Range ~ 6×10^{-10} Calibration Auto A OK

IC-4 " 1×10^{-9} Calibration Auto B OK

No Source, Off OK, Red Lite OK Bypass OK C OK

EXP. # 354

4x4x4 Array No EXTRA Uranium on top of Shelves

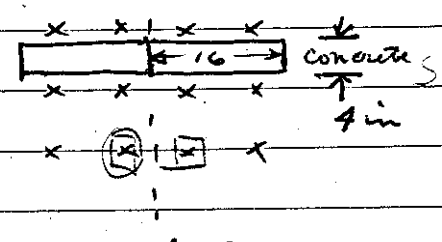
Added 2 ea 4x8x16 Concrete Blocks 1 ea

on Movable Table and Fixed Table, top shelves.

1[38] Start Assembly

1[48] Table Closed DPI W = .107

DPI E = .103



Subcritical – IC-2 $.35\times3\times10^{-11}$

-3 2.4×10^{-12}

-4 1.0×10^{-12}

1[58] Shut Down

EXP #355

ADD 4 ea $1\frac{1}{2}\times3\frac{1}{4}\times3\frac{1}{4}$ @ 17.7 or 70.8 ¢

2[01] Start Assembly See Red D on sketch above

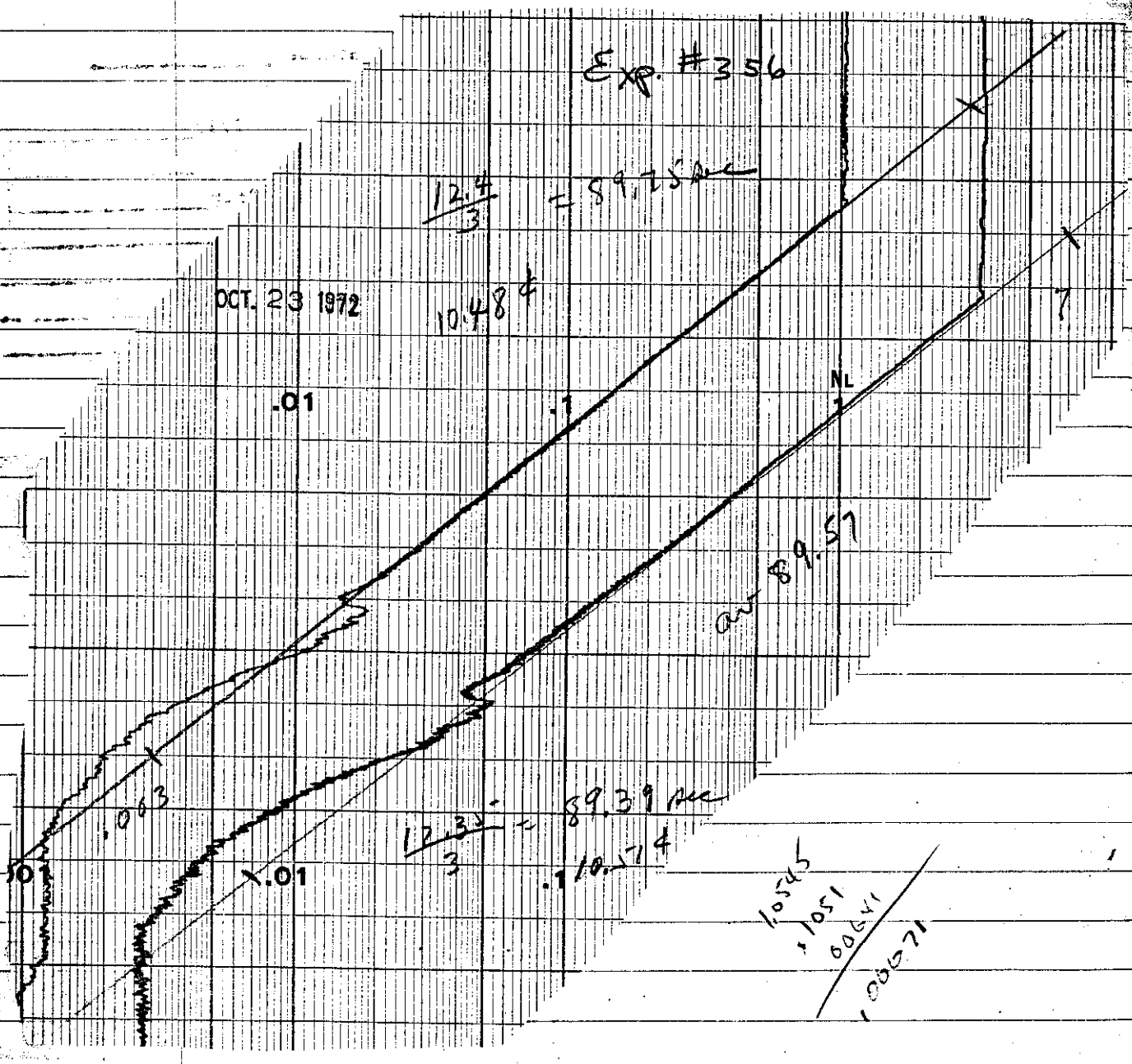
DPI W .279 } On Pos Period

DPI E .278 }

2[13] Start to level Δ DPI

.413 – .107 = .306

2[20] Shut Down .408 – .103 = .305


Exp. #356
12.4/3 = 89.75 sec
OCT. 23 1972
10.48 ¢
.01
.1
NL
7
av 89.57
.003
12.35/3 = 89.39 sec
10.57 ¢
.01
.1
1.0545
.1051
.00641
.00671

OCT. 23 1972

EXP #356

Remove 2ea $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$ (See ⊠ on sketch

Now 2ea Remain see ⊠ on sketch

3 30 Start assembly use source.

3 39 Tables Closed on Pos. Period 0.104 W } K = 1
0.102 E } 0.183 W
0.180 E

3 50 Shut Down

Level.

ΔDP/W = .079

E = .078

Tables Closed 2ea $1\frac{1}{2}$ 2 concrete +10.5

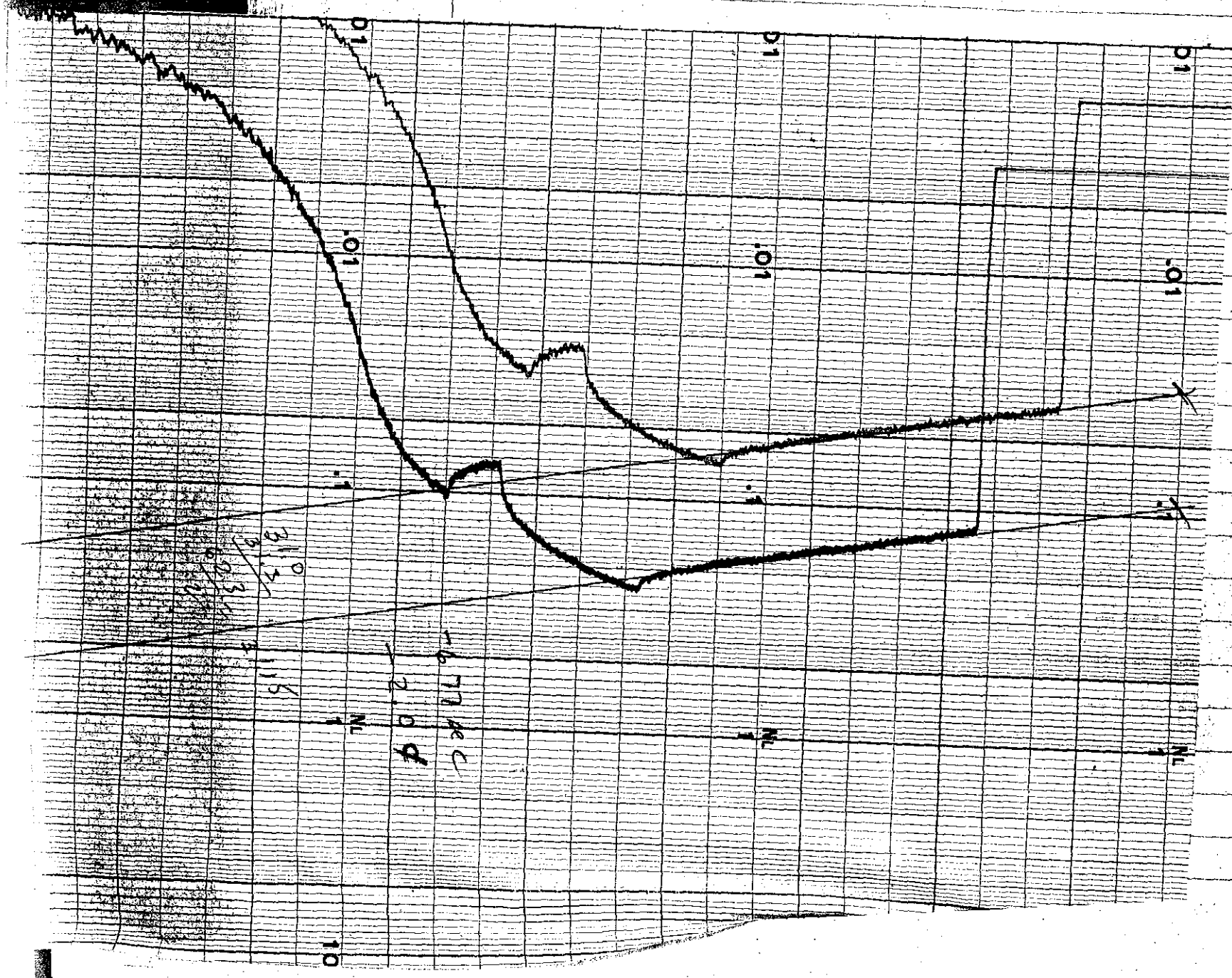
Tables Closed 2ea $1\frac{1}{2}$ 0 " + 4.8

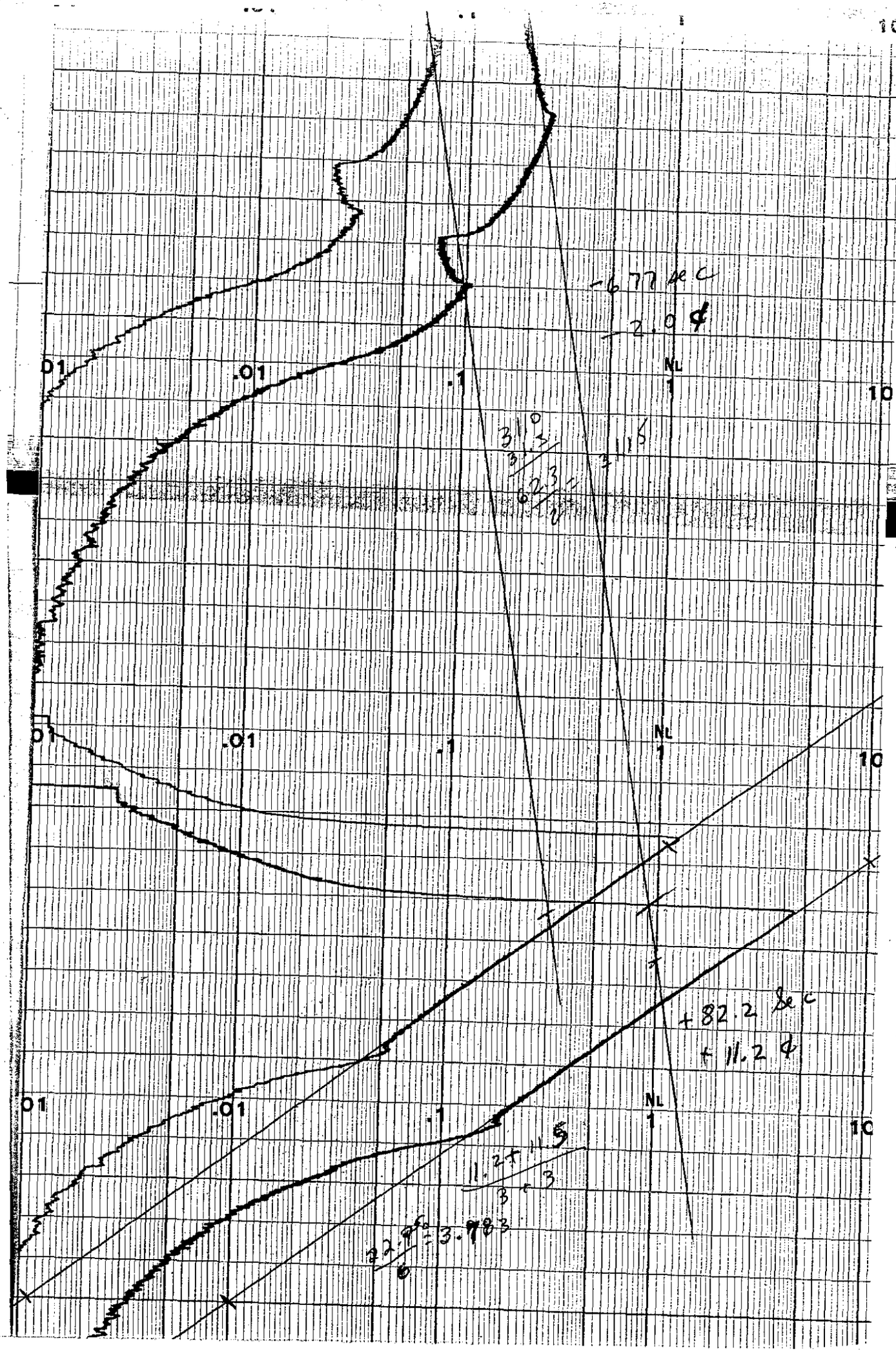
5ea × 17.7 = 88.5 − 5.7 = 82.8

Therefore, 1ea concrete = 41.4 ¢

The above [illegible] is repeated on p35-37

(The above estimate is repeated on p35-37)


.01
.01
.01
.01
.1
.1
.1
NL
NL
NL
10



10
.01
.01
.1
NL
1
10
-6.77 sec
-2.0 ¢
31.0
31.3
62.3
2
31.15
+82.2 sec
+11.2 ¢
11.2+11.5
3+3
22.95
6
= 3.983

Instrument Check on 10-24-72 Source 10 mc ^{60}Co

Bal 7.85 PM-1 950 V Low Trip OK H. Trip Scram Tabs

IC-1 3×10^{-10} Meter Trip OK Fast Trip OK

IC-2 3×10^{-10} Meter Trip OK Rad Mon Alarm

IC-3 8×10^{-11} Calibration DWM A OK

IC-4 1×10^{-10} Calibration DWM B OK

Δp = OK Bypass Red Lite C OK

Repeat Reactivity Meas for 2 concrete Blocks and with 2 ea $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$

EXP # 357 (Repeat #356) p 33

8 40 AM Start Assembly

8 48 On Pos. Period, Tables Closed DPI W = .105 DPI E = .102

8 52 Shut Down ↘ +82.2 sec → +11.2 ¢

#356 +10.5 ¢

ΔR = +0.7 ¢

Repeat React. Meas with No Concrete Blocks as Mod. and with 7 ea $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$

EXP # 358 (Repeat #345 p. 17)

9 07 AM Start Assembly

9 16 AM On ~~Pos~~ Neg Period DPI W = .105 DPI E = .102

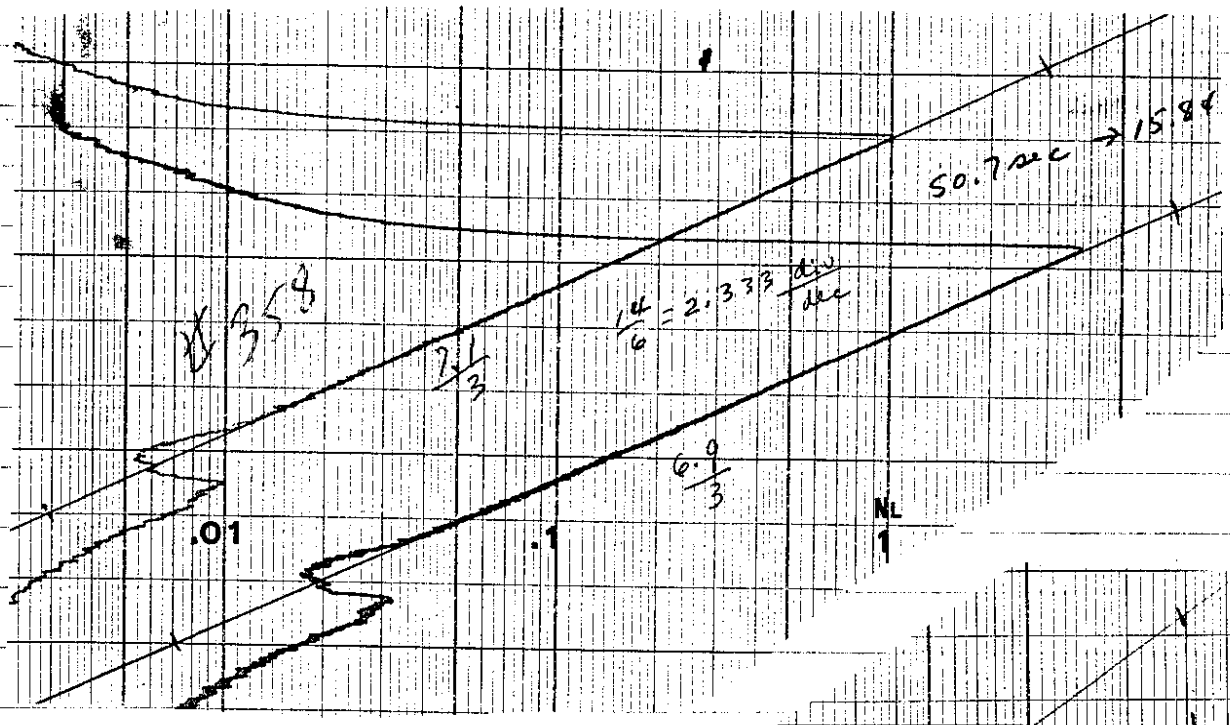
~~Shut Down~~ Insert Source to Raise Power to IC-3 =

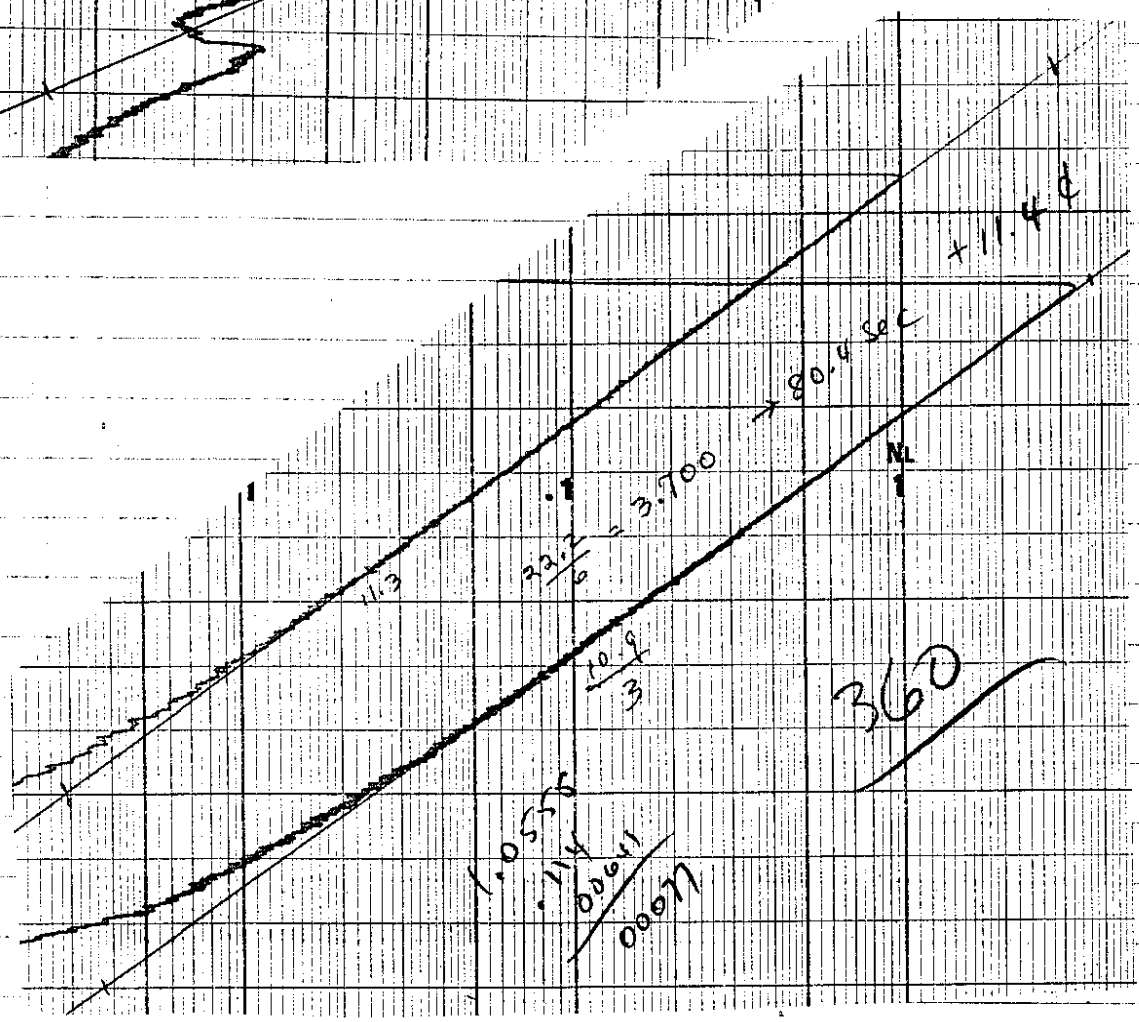
9 20 Remove Source for Neg Period −677 sec → −2.0 ¢

9 24 Shut Down

#345 +4.8

ΔR = −6.8 ¢


50.7 sec → 15.84
14/6 = 2.333 div/dec
7.1/3
6.9/3
.01
.1
NL
1


+11.4 d
→ 80.4 sec
32.2/6 = 3.700
10.9/3
360
1
.1
NL
1

EXP #358 A

Repeat #346 with 8 ea 1½ x 3¼ x 3¼

9 40 Start Assembly

9 47½ On Pos Period DPIW = .107 DPIE = .102

Shut Down 50.7 sec → +15.84

Δk for 1½ x 3¼ x 3¼

= 15.84 + 2.0 = 17.8 ¢

8

142.4

− 15.8

126.6 ¢

Reactivity of 4x4x4 Array

−126.6 ¢

EXP # 359

Purpose: Measure React Change for Double Unit, Horiz.

4 ea 1½ x 3¼ x 3¼ (→ 71.2 ¢) see Red ☒ on sketch

10 20 Start Assembly

10 28+ Tables Closed — Subcritical

Source In 2.8 x 10⁻¹¹ on EC-3

DPIW = .108 DPIE = .103

EXP # 360

Add 3 ea 1½ x 3¼ x 3¼ (See Purple X on Sketch)

Start Assembly

Tables Closed On Per Period DPIW .107

E .103

Δk for Double Unit = 11.4

in region of higher importance 2.0

13.4 ¢

5.4

8.0 ¢ due to Self Mult. of Unit

EXP #361

Measure React. of 8 Double Unit on top Shelf

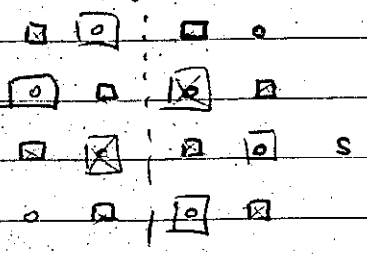
Double Units are vertical.

Pers. ck Rel Lite ✓ Bypass ✓ Ap ✓ Source ✓

1^{30} Start assembly

1^{38} Tables Closed IC-3 6.5×10^{-12}

1^{40} Shut Down No Source 1.4×10^{-12}



DPIW = .107

E = .103

EXP #361-A at vacant sites

Add 4 ea $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$ (8 ea 0.75 in. Thick)

(Purple Squares on Sketch □)

1^{55} Start assembly

2^{03} Tables Closed W 107

E 103

IC-3 1.2×10^{-11}

No Source $4. \times 10^{-12}$

2^{04} Shut Down

EXP #362

Add 2 ea $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$ To ☒

central 2 vacant sites, Now

2^{12} Start Ass. 6 ea $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$

$2^{19\frac{1}{2}}$ Tables Closed W .106 E .104

Subcritical IC-3 2×10^{-11}

Source Out IC-3 9×10^{-12}

EXP # 363

8ea ☐ Double Unit, Vert.
4ea ☒ 3 x 3¼ x 3¼
2ea ☒ 1½ x 3¼ x 3¼

30½ Start Assembly
38½ On Pos Period DPIW 107
40 Shut Down E 105
Screw Only to 47 (7 in.)
+24.2¢

1.066
.242
.00641
.00125

EXP # 364 (Movable Table)

Remove 1 ea 1½ x 3¼ x 3¼ Insert Source
46½ Start Reassembly screw from 47 Rev.
52 On Pos Period DPIW .108
53½ Source Out E .105
+4.9¢

1.049
.0484
.00641
.00037

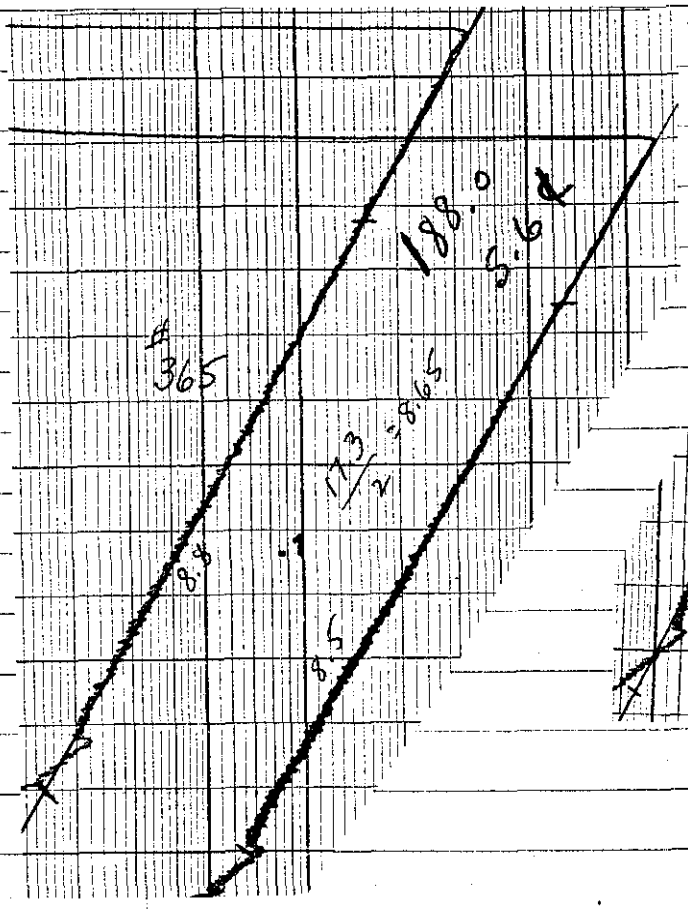
EXP # 365

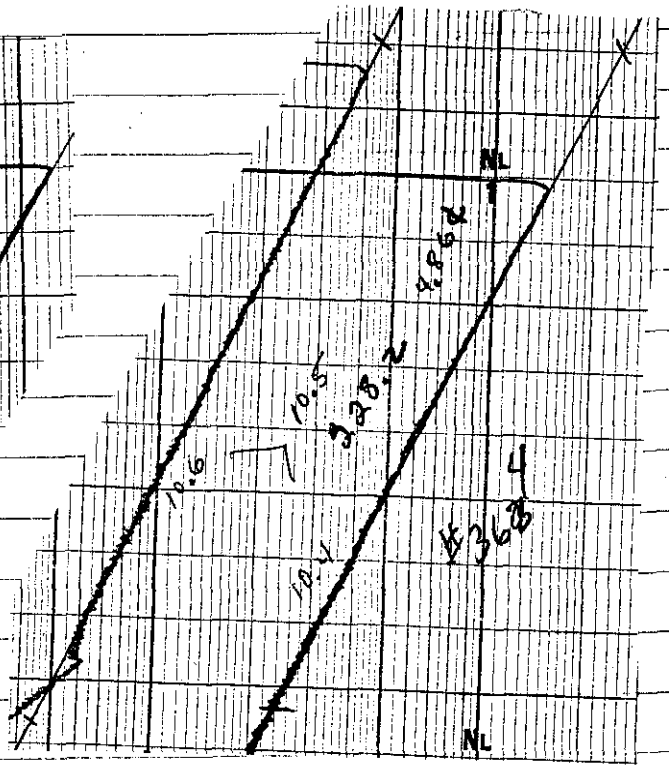
Remove 1 ea 1½ x 3¼ x 3¼ from the fifth
3 x 3¼ x 3¼, and 1½ x 3¼ x 3¼ to central

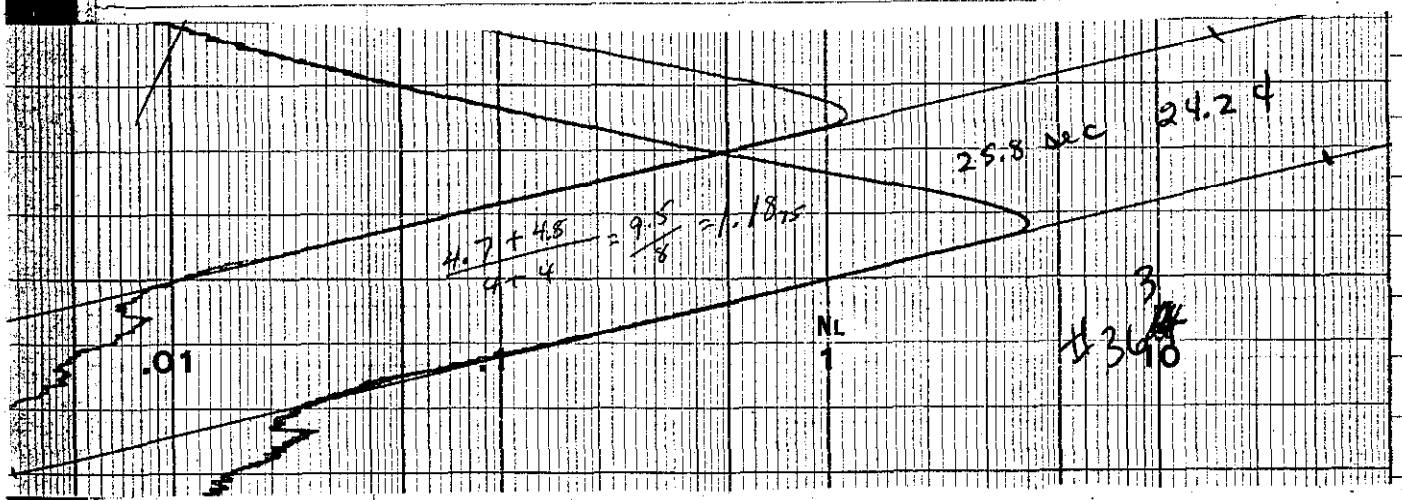
Now 8 ea 7½ x 3¼ x 3¼
3 ea 3 x 3¼ x 3¼
3 ea 1½ x 3¼ x 3¼

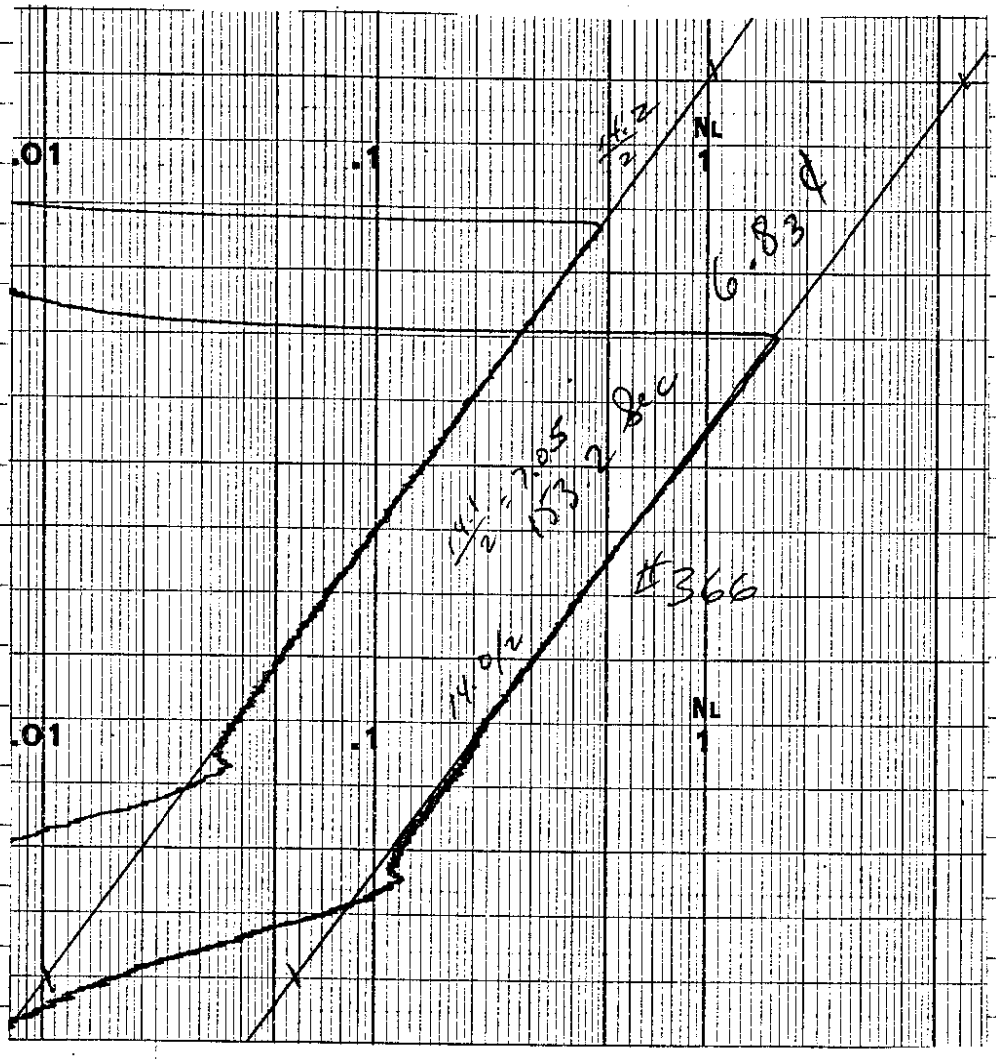
3 09 Start Assembly DPIW .108
3 17 On Pos Period E .104
~ 3 25 Shut Down +5.6¢

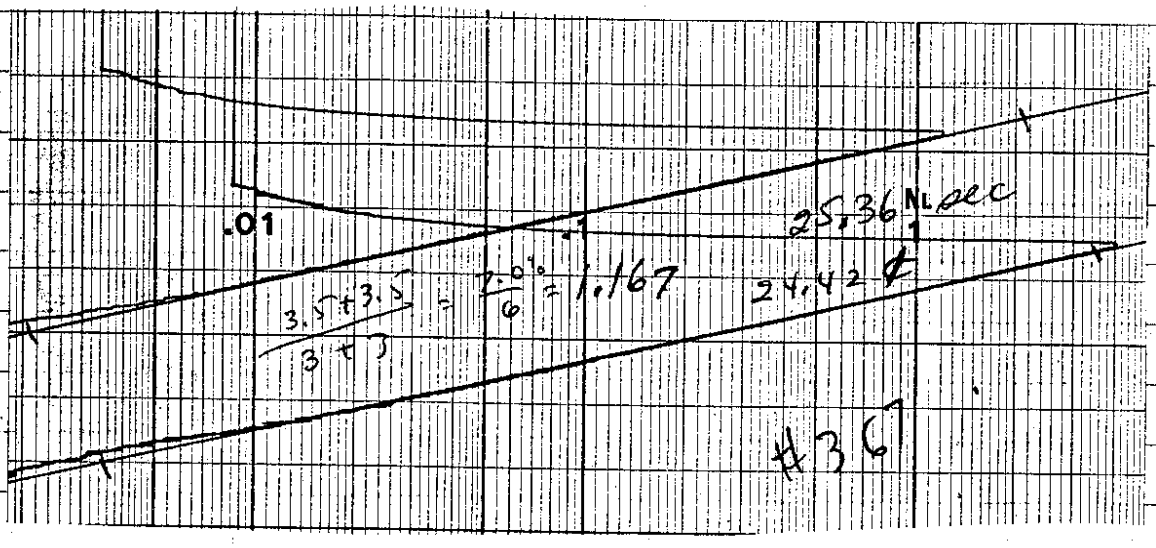
1.050
.056
.00641
.00038


188.0
5.6 ¢
#365
17.3/2 = 8.65
8.8
.1
8.5


NL
1
4.86 ¢
10.5
228.2
10.6
10.4
#364
NL

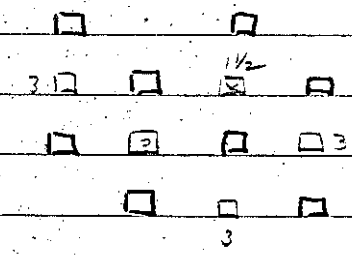

25.8 sec
24.2 ¢
4.7 + 4.8 / 4 + 4 = 9.5/8 = 1.18 75
.01
.1
NL
1
#363
10


.01
.1
NL
1
14.2/2
6.83 ¢
14.1/2 = 7.05
153.2 sec
#366
14.0/2
.01
.1
NL
1


.01
.1
NL
1
25.36 sec
3.5+3.5 / 3+3 = 7.0% / 6 = 1.167
24.42 ¢
#367

EXP # 366

Move 1½ x 3¼ x 3¼ to on top of 1½ central unit



3 35 Start Assembly Source Ins.

43 On Pos Per W .108+

49 Shut Down E .104

+6.8 ¢

1.051
.0683
.00641
.00046

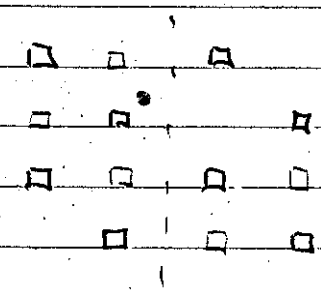
EXP # 367

Move 1½ To Outside

Add 1½

Now Sea 3 x 3¼x3¼

8 ea double Units



3 59½ Start ass (No Source)

4 06+ On Pos. Period. DPI W=.108

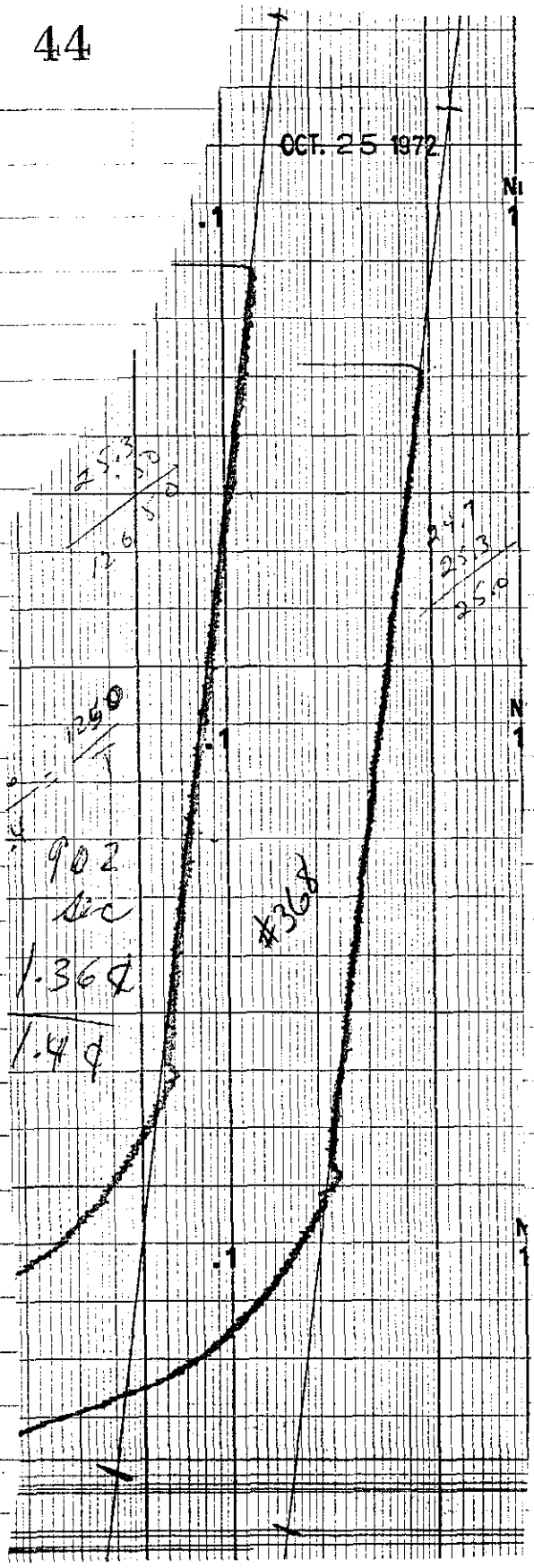
DPI E=.104

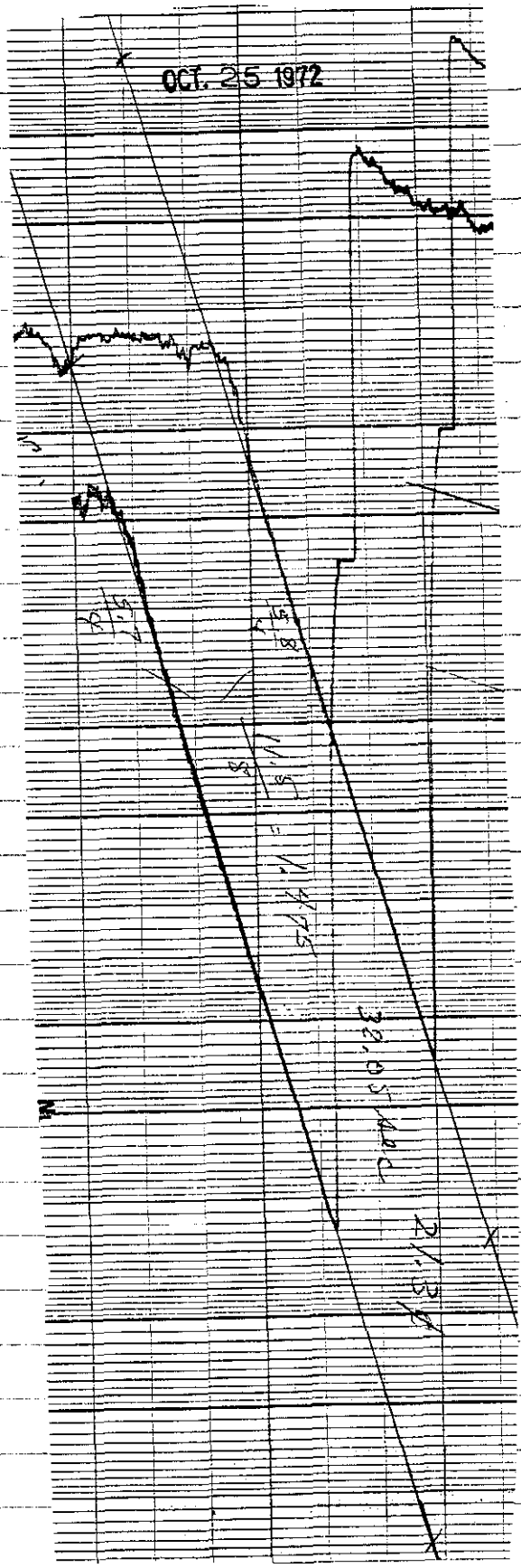
+24.4 ¢

1.066
.244
.00641
.00167

Summary

1 ea 3 in (8 Faces [illegible])	36.9
1 ea 1½ in (8 Faces)	[illegible]
1 ea 3 4 [illegible]	38.8
1 ea 1½	19.3
4x4x4 array with 8 doubles and 8 [illegible]	-186.4 ¢
(4x4x4) = -126.6 ¢ [illegible] →	-59.8 ¢


OCT. 25 1972
.1
.1
.1
902
sec
1.36¢
1.4¢
#368


OCT. 25 1972

OCT. 25 1972 DWM JJL

Instrument Check on 10-25-72 Source 10 mc ^{60}Co

875V PM-1 Bal 7.90 Low Trip OK Trip OK

IC-1 3×10^{-10} Meter Trip Scram Tables Fast Trip OK

IC-2 3×10^{-10} Meter Trip OK Rad Mon. Alarm

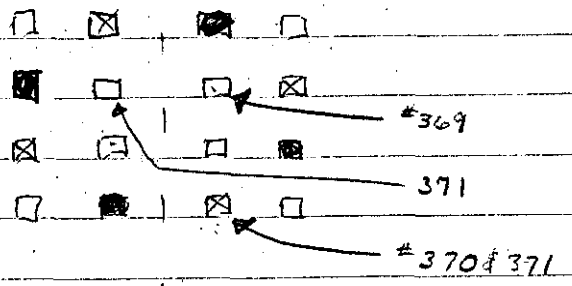
IC-3 6×10^{-10} Calibration DWM A OK

IC-4 1.4×10^{-9} Calibration DWM B OK

ΔP - OK Rad Pers. Ch OK By pass OK C OK

Purpose: To Measure React. Change for 4 double Units.

EXP. # 368



10 08 Start Assembly

10 16 Tables Close DPI W .106 E .104

Power Inc Slowly w. Source.

19 Remove Source, super crit on Pos Period.

30 Shut Down. +902 Sec → +1.4¢

☐ Single

☒ 3×3¼×3¼

■ Double Vert

1.0465
.014
.00641
.00009

EXP # 369 OCT. 25 1972

ADD 1½ × 3¼ × 3¼ To Central Position indicated on sketch

Meas React change

39 Start Assembly

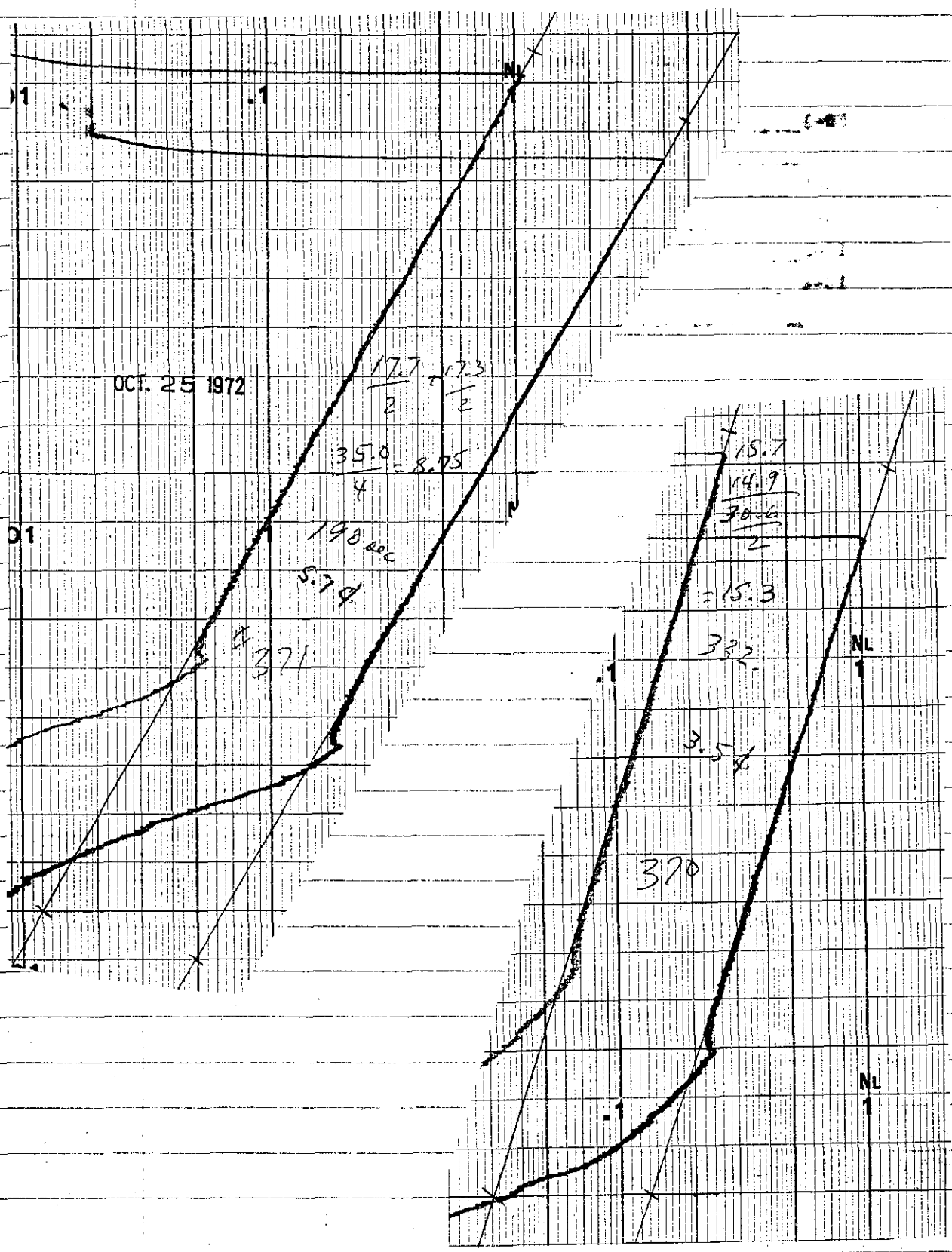
50½ On Pos Period DPI W .106 E .105

Shut Down

+32.05 Sec → +21.3

Central 1½ × 3¼ × 3¼ → Δk = 19.9

1.0635
.213
.00641
.00145


OCT. 25 1972
NL
.1
17.7/2 + 17.3/2
35.0/4 = 8.75
190 sec
5.7¢
371
15.7
14.9
30.6/2
= 15.3
332
3.5¢
370
NL
1
.1

EXP #370 OCT. 25 1972

Remove $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$ from $3 \times 3\frac{1}{4} \times 3\frac{1}{4}$ pile indicated on sketch

11^{05} Start Assembly

11^{13} On Pos Period 11^{15}, Source Out DP1 W = .108

11^{25} Shut Down E = .103

1.048
.035
00641
00024

+332 Sec → + 3.5 ¢

Δk = 17.8 ¢ Top $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$

EXP #371 OCT. 25 1972

Add $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$ to Central Posi Movable Table } See Sketch

Remove $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$ from Position on Fixed Table }

4 Central Units 2 w. $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$

11^{30} Start Assembly 4 Double Units (Face Position)

11^{30} On Pos Period .109 .104 4 Corner Unit

$38\frac{1}{2}$ Source Out 3 ea $3 \times 3\frac{1}{4} \times 3\frac{1}{4}$ (Face Positions)

Shut Down 1 ea Vacant Face Position

1.050
.037
00641
000383

+ 190.1 sec → 5.7 ¢

worth

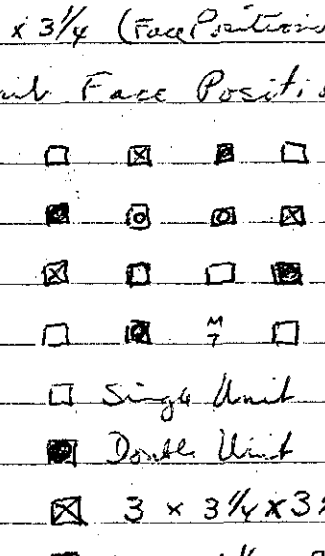
Bottom Half = 3.5 ¢
19.9
23.4
− 5.7
17.7
17.8
35.5

Worth of 3 in $\times 3\frac{1}{4} \times 3\frac{1}{4}$

x 4
142
1.4

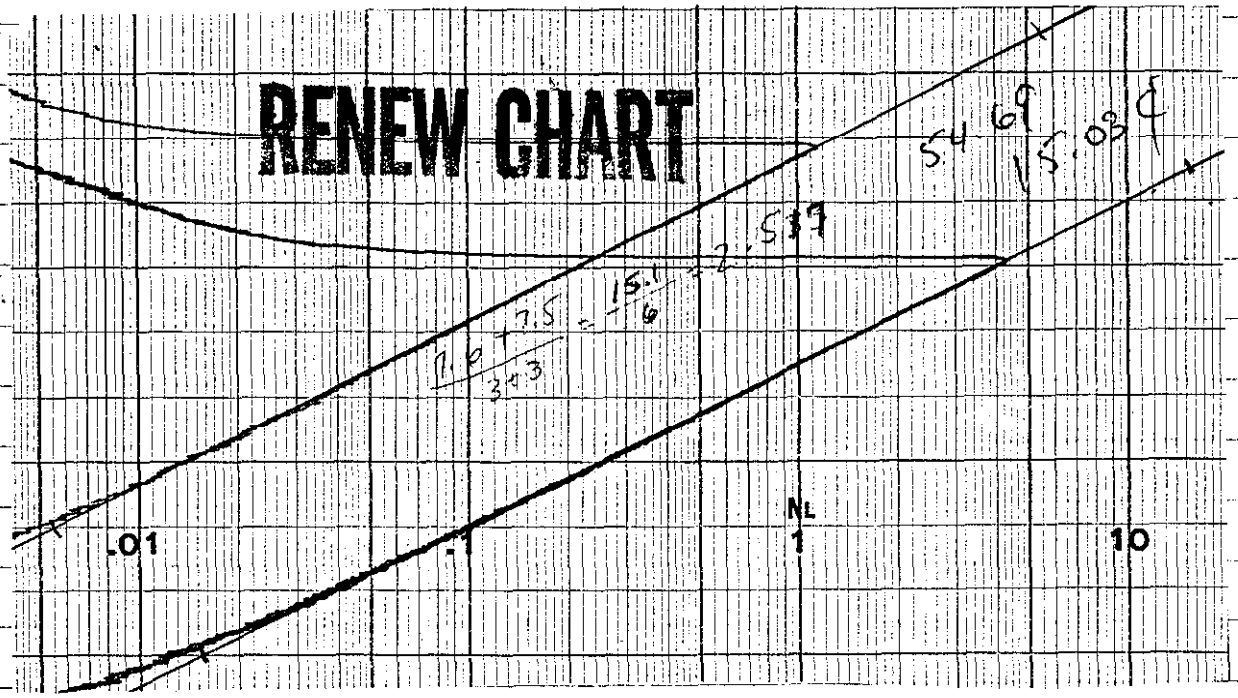
□ ⊠ ■ □
■ ⊡ ⊡ ⊠
⊠ □ □ ■
□ ■ M T □

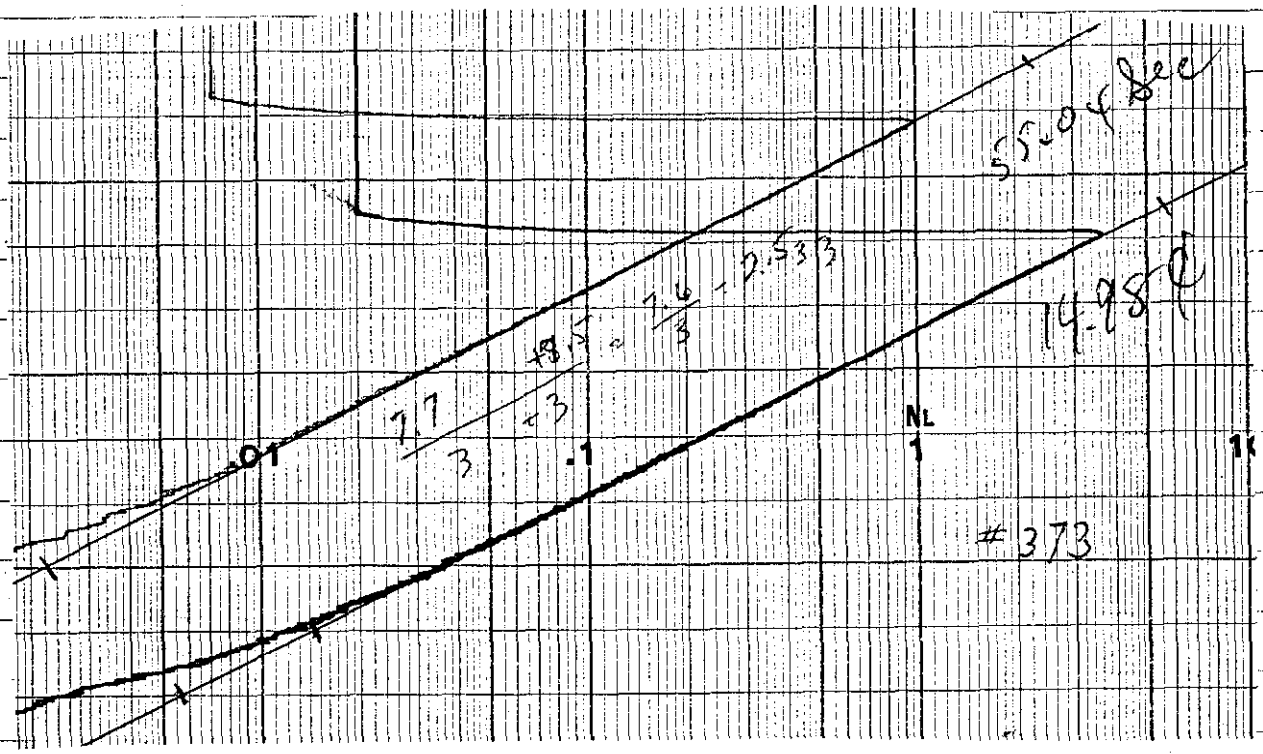
□ Single Unit
■ Double Unit
⊠ $3 \times 3\frac{1}{4} \times 3\frac{1}{4}$
⊡ Unit + $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$



64 Assembly w. 4 Doubles → −140.6 ¢

OCT. 25 1972


RENEW CHART
54.69
15.08 ¢
2.519
.01
.1
NL
1
10


55.04 sec
14.98 ¢
2.533
.01
.1
NL
1
#373

EXP #372

Repeat 4X4X4 Array with 8ea $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$

[Repeat EXP #358 and #346]

1 15 Start Assembly (No Source) Bypass OK, ΔP OK, Red Lt Pen OK

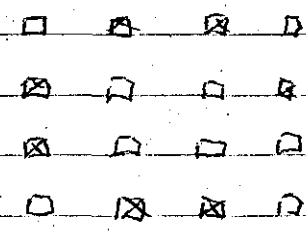
1 23 On Pos Period DPI W .107
DPI E .104

1 27 Shut-Down

+15.0 ¢

−142.4
+15

ρ = −127.4 ¢ for 4x4x4



□ Single Unit

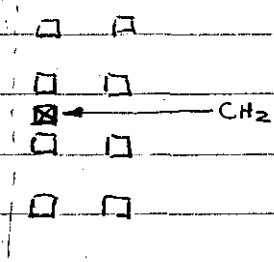
⊠ " "

with $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$

EXP #373

Add 1ea $(3\frac{3}{4})^3$ CH_2 in Middle 3rd Tier Fix Tabled

Remove 2ea $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$ from Movable Table



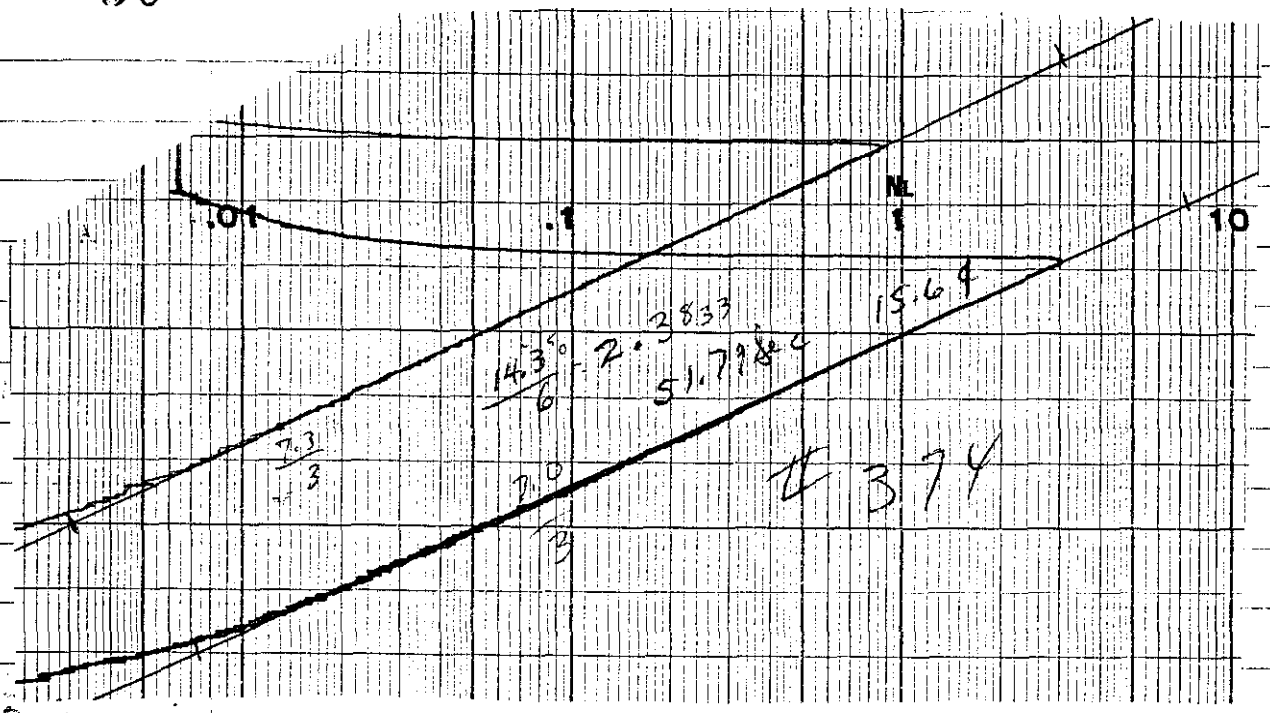
1 35 DM Start Assembly

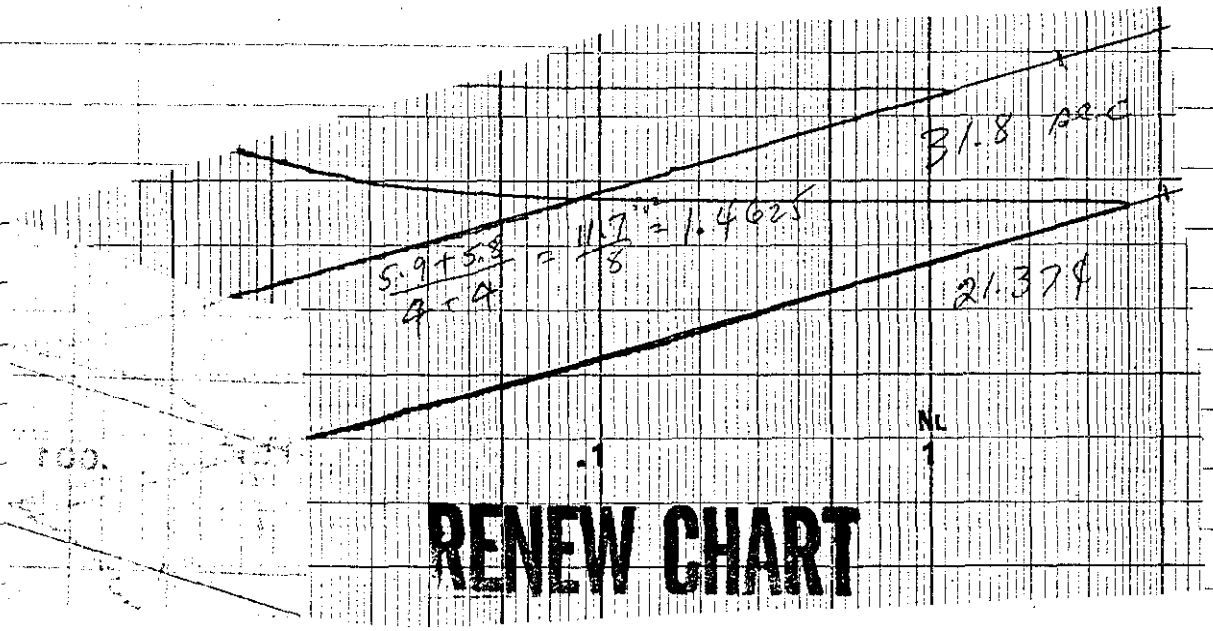
1 43 On Pos. Period DPIW = .107
E = .104

Shut Down

1.054
.150
.0064
00101

+15.0 ¢ 1ea 35.6


.01
.1
NL
1
10
15.6¢
51.79 sec
7.3
3
7.0
3
374


31.8 sec
21.37¢
.1
NL
1
RENEW CHART

EXP #374

Add CH_2 $(3.75)^3$ Middle of 3rd Shelf Movable Table

Remove 2ea $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$ from Toplayer Fixed Table

Now 4ea $1\frac{1}{2} \times 3\frac{1}{2} \times 3\frac{1}{4}$

2ea $(3.75)^3$ CH_2

1.0585
.156
.00641
.01106

2^{00} Start Assembly
2^{08} On Pos. Period 0.107
2^{12} Shut Down 0.104

+15.6 ¢

1 ea CH_2 = 2 ea $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$ U = 35.6
2 × 17.8 + .6
2nd one 36.2 ¢

vs 35.6

EXP #375

Add 2ea CH_2 Middle of 2nd Fix & Mov. Table

Remove 4ea $1\frac{1}{2} \times 3\frac{1}{4} \times 3\frac{1}{4}$

Now 4×4×4 Array

with 4ea $(3.75)^3$ of CH_2

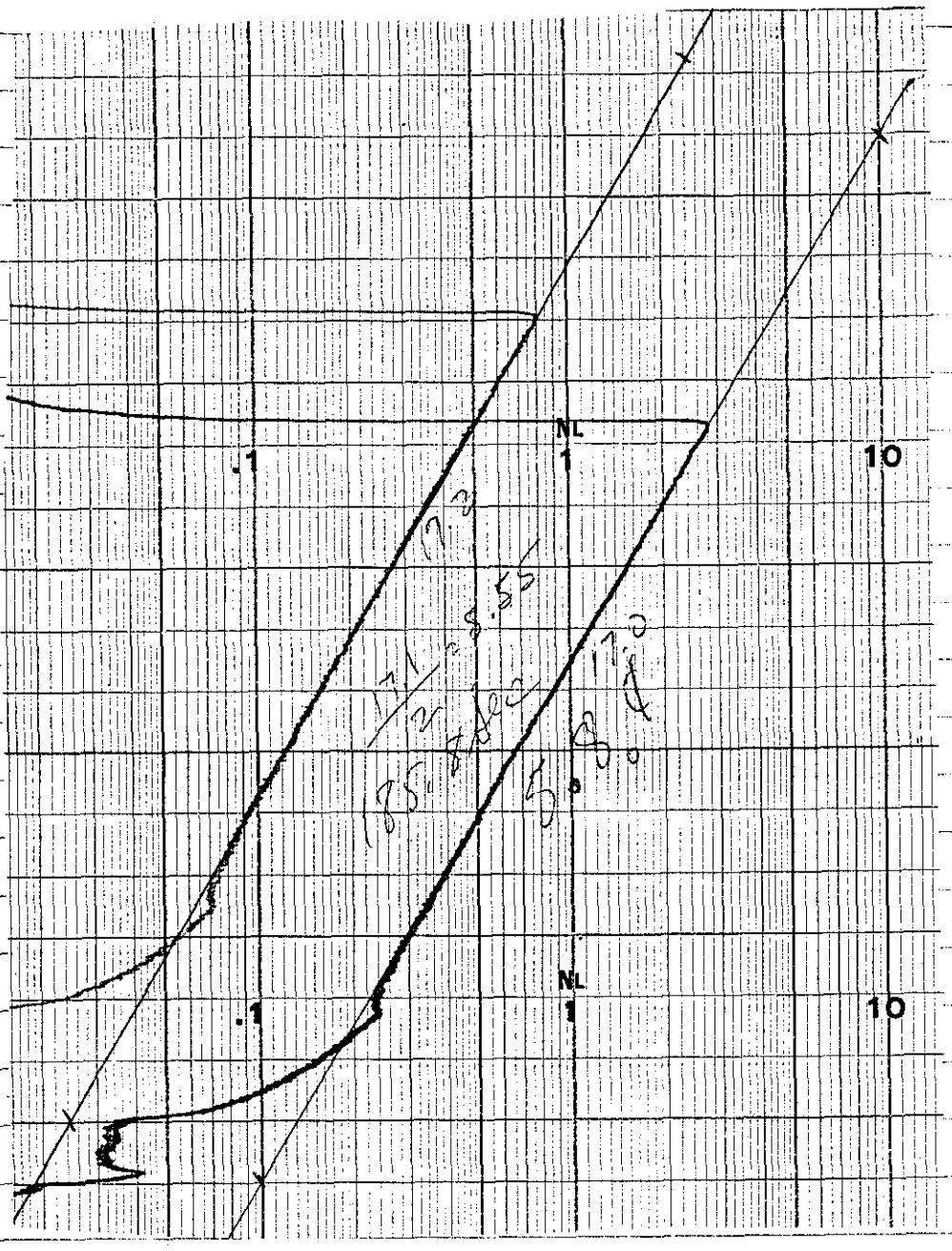
1.0635
.2137
.00641
.00146

2^{24} Start Assembly
2^{32} On Pos Period .105
2^{36} Shut Down .105

+21.37
15.6
5.8
71.2

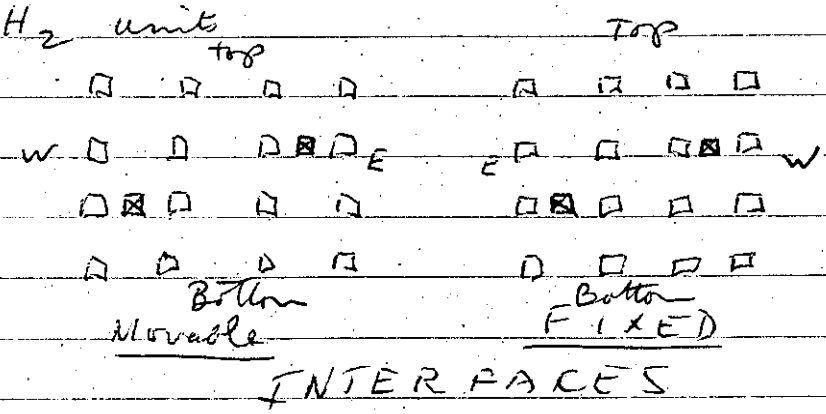
2ea CH_2 = 77.0 ¢

1 ea 38.5 vs 36.2 & 35.6


.1
NL
1
10
.1
NL
1
10

#376

Moved CH_2 units



INTERFACES

2^{53} Start assembly

3^{01} On Pos Period Table Closed 0.107 -
Insert Source to Raise power 0.104

3^{08} Shut Down

+5.8¢

$$\begin{array}{r} -15.0 \\ +5.8 \\ \hline 142.4 \quad -9.2 \end{array} = \frac{133.2}{4} = 33.3$$

vs 35.6¢

for central position. lea

1.050
.058
00651
00039

KENO Description of 4X4X4 Array

	±X	±Y	+Z	-Z
U	±4.7625	±4.7625	4.7625	-4.7625
AIR	±10.16	±10.16	15.4762	-4.7625
Al	"	"	"	-4.8438 .0813
CORE	±40.64	±40.64	61.9048	-19.3752
AIR	±40.80	±40.80	62.54	-19.88
CONCRETE	±81.44	±81.44	62.54	~~-49.86~~ -50.04 30.66
CH_2	"	"	78.54	"

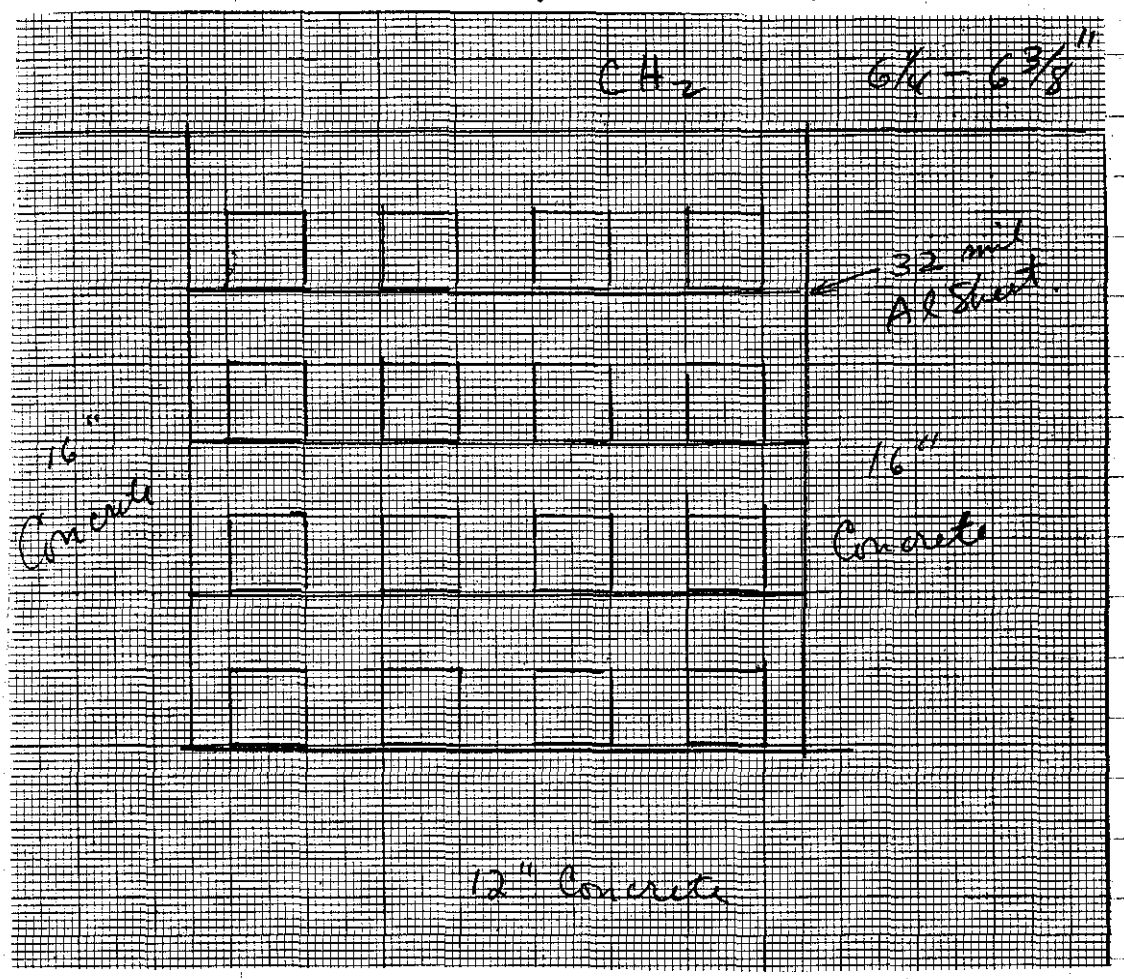
16" Core

Cavity measurements

Height 32 1/4

Width 32 1/8

Depth 16 1/16 + 16 1/16 = 32 1/8



Concrete Sample Submitted to Y-12

Req No 684639

4.023 x 8.071 x 16.00

10.22 x 20.50 x 40.64

40.88 x 41.0 x 40.64

On Oct 26, 1972, ADC suggested mixing some 93% metal with the U(30) metal array. Since the 4x4x4 array concrete & CH_2 reflected, $(8\ in)^3$ cells is subcritical by ~13 requiring 8 ea

3272.5	av wt	1"
792.4		1/4"
417.5		1/8"
417.5		1/8"
4899.9 g	or 1837.46 g	^{235}U
	x8 = 14699.7 g	^{235}U

for the 8 ea 1 1/2 x 3 1/4 x 3 1/4 stacks

Average 3.75 cube weighs 16.219 kg
6.080 kg ^{235}U
8 = 18.77

Therefore if 1 ea U(30) 6.080 kg
replaced 1 ea 10.48
ΔM 4.4 kg

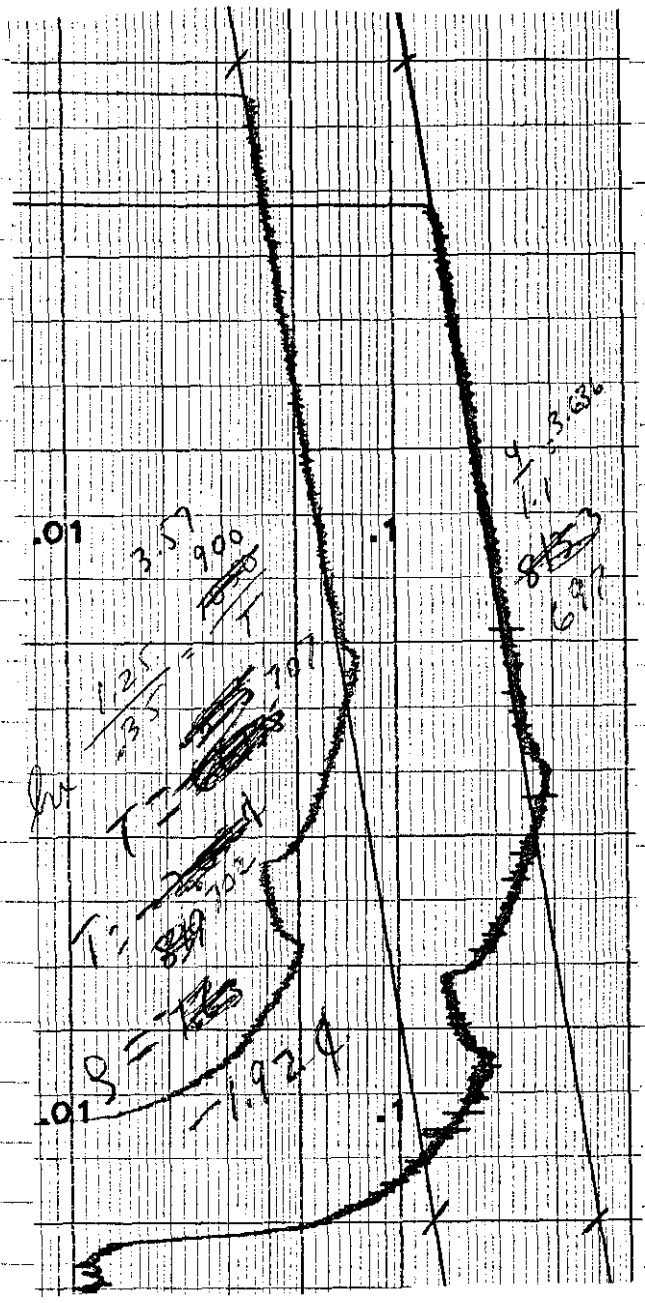
If 3 ea are replaced
^{235}U Mass increase is 13.2 kg

DWM 10-26-72

JJL will get 16 ea 10.48 kg cylinders from vault and store on one shelf in 113, in a line on 6 in centers or greater

DWM

JJL will also get 8 ea 5.2 kg pieces.



1.044
-.0192
-.00641
.000128

Instrument Check on Oct 27, 72 Source 10 mc ^{60}Co

Bal 8.75

PM-1 8.75 Volts Low Trip OK Trip OK

IC-1 3×10^{-10} Motor Trip OK Fast Trip Scram Tables

IC-2 3×10^{-10} Motor Trip OK Rad Mon Alarm

IC-3 8×10^{-10} Calibration Drawn A OK

IC-4 9×10^{-10} Calibration Drawn B OK

Bypass OK Dp OK C OK

Insert Source M230 Red Lite OK Top Shelf

Resp. OK Top View

EXP #379

1^{51} Start Assembly

Purpose: MIXED 3 ea U(90) 10.466 kg units with 61 ea U(30) 16.24 kg units

U(30) ~~3.75~~ 16.24 kg

U(93) 10.~~24~~ 46

2^{03} Tables Closed .105 W .102 E ~~Near~~ crit.

U(93) in pairs

2 Insert Source to Raise Power

20962

2^{09} Remove Source for Neg Period

R = 5.76

2^{16} Shut Down

Z = 10.80 → 5.40 each

−1.92 ¢

S = 18.62

235 = 4.448×10^{22}

238 = 3.201×10^{21}

Used #2190 10.443

2193 10.473

2195 10.483

31.399

3

10.466 average

Remove 2193 replace cube

Add #2473 − 5.210

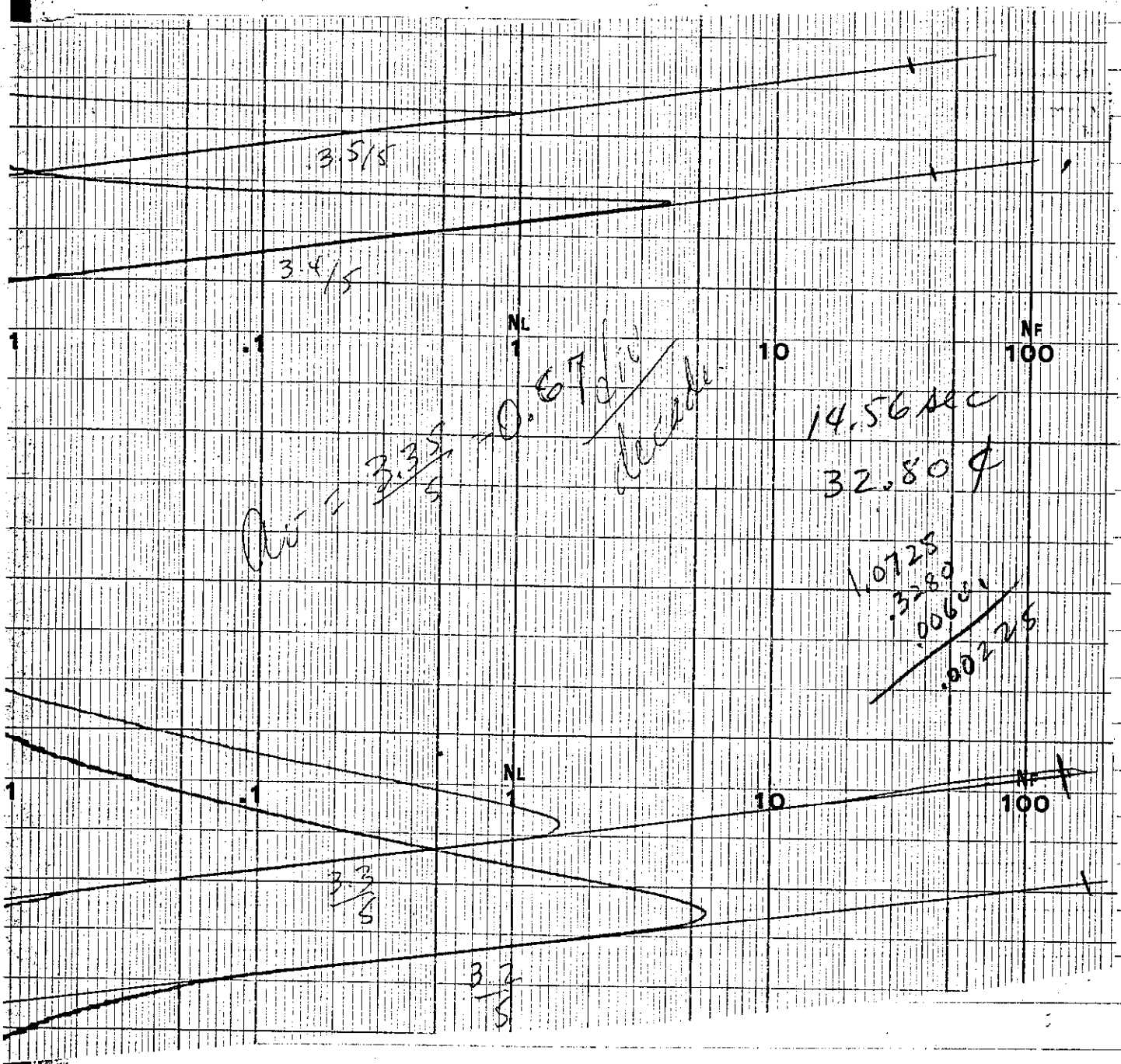
10.466 kg Unit

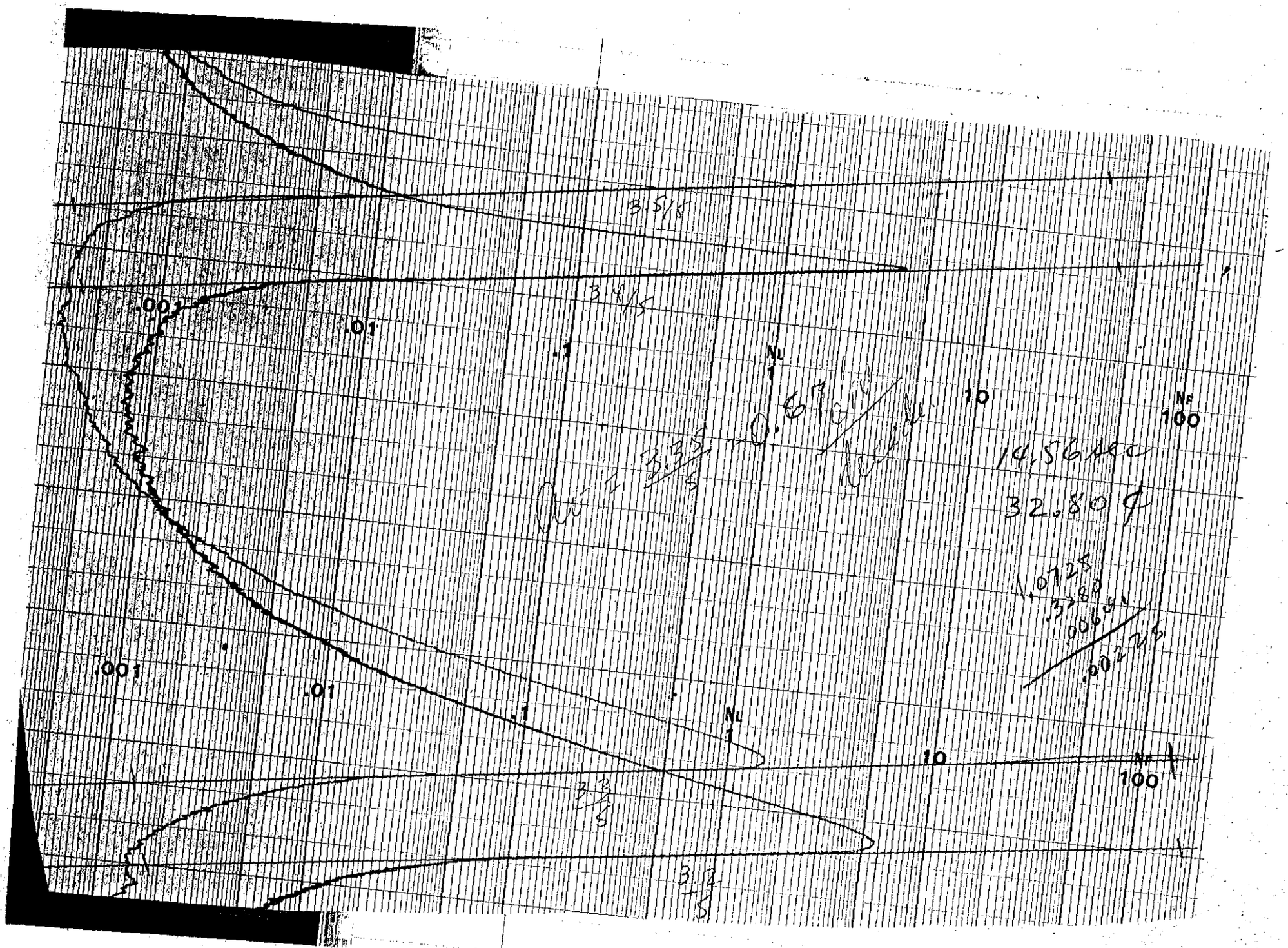
15.676 kg Unit

26.134 kg U added

12.18 kg ^{235} remove

14. kg

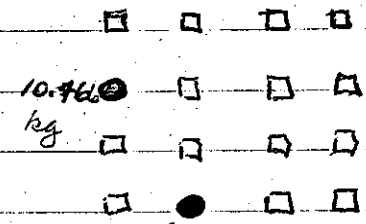

3.5/5
3.4/5
NL
NF
1
.1
1
10
100
14.56 sec
32.80 ¢
1.0725
.3280
.00601
.00225
3.3/5
3.2/5



3.5/5
3.4/5
.001
.01
.1
NL
1
10
NF
100
14.56 sec
32.80 ¢
1.0725
.3280
.00225
.001
.01
.1
NL
1
10
NF
100
3.3/5
3.2/5

EXP # 380

2:26 Start Assembly
2:34 On Pos Period
2:36 Shut Down Screw Only

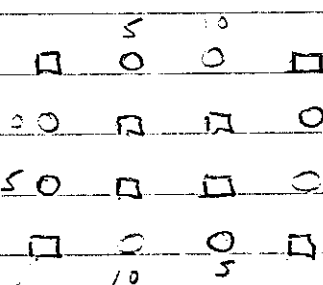


EXP # 381

2:43 Re assemble To repeat Period
~ 47 On Pos Period
. 49 Shut Down

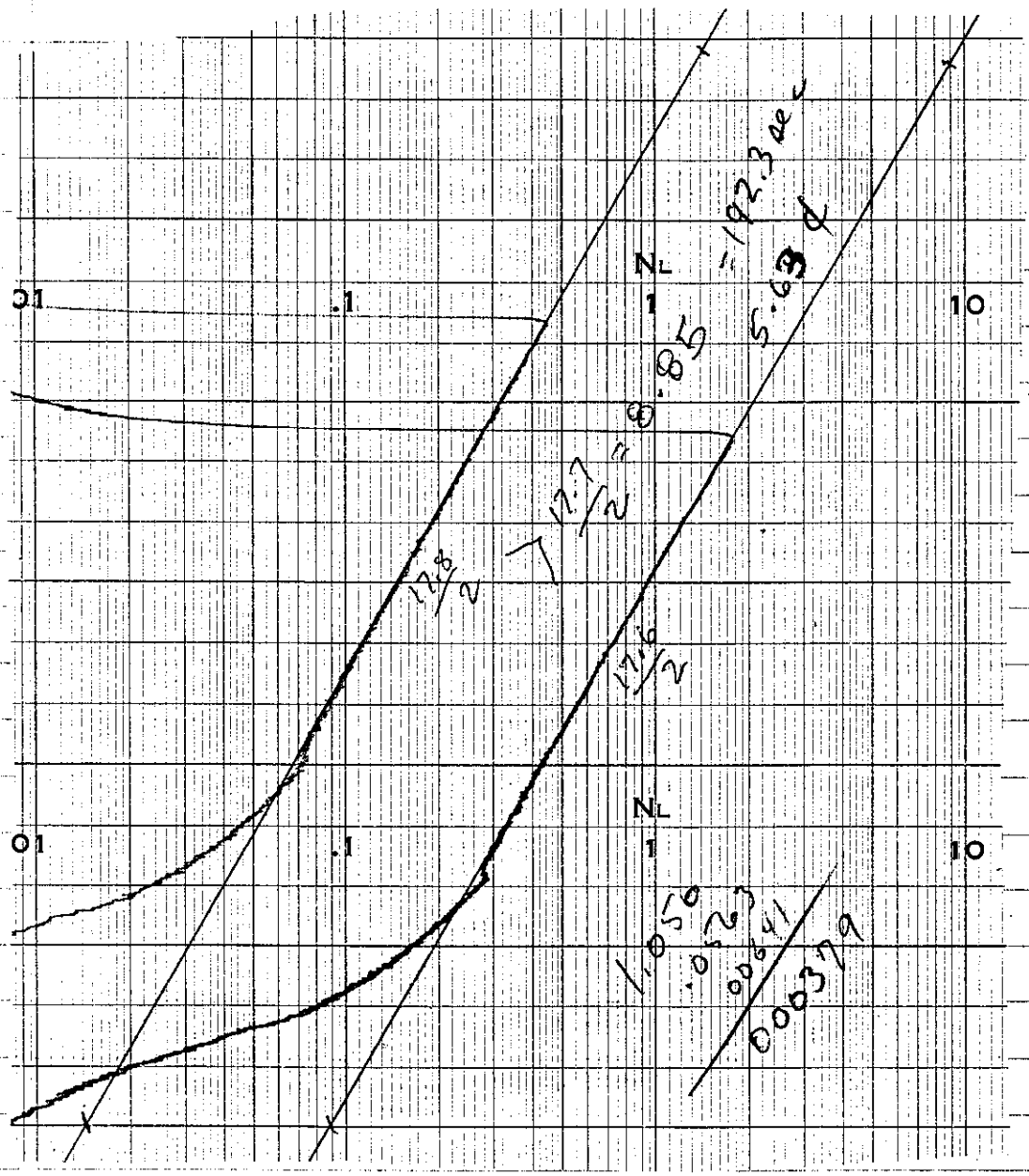
EXP # 381

4 ea 10 kg U(90)
4 ea 5 kg U(90)
8 ea 16. kg U(30)
See sketch



this Arrangement has 14.0 extra kg of ^{235}U over the 4x4x4 array

3:12 Start Assembly
Tables Closed 105 103
Sub critical Source level to ~ 6×10^{-11}.
Pull source 4×10^{-11}



NL
01
.1
1
10
NL
01
.1
1
10
17.8/2
17.7/2 = 8.85
17.6/2
= 192.3 sec
5.63 d
1.056
.0563
00641
000379

#382

~~Add 1ea (3.75)^3 CH_2~~ Remove 1ea 5kg U(90)

Add 1ea (3.75)^3 U(30)

Now ~ 15.1 kg ^{235}U excess

over 4×4×4 Array

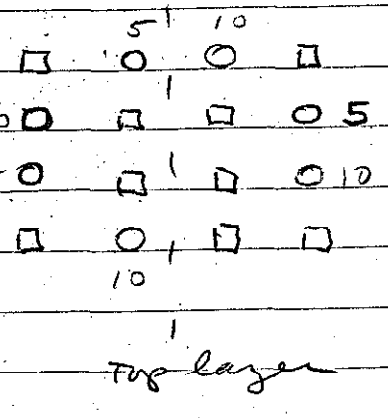
3^{34} Start Assembly

~~[illegible]~~ Tables Closed 10.5 W 10.4 E

3^{44} Subcritical IC-3 ~10^{-10} 1.3

3^{47+} Neg Period Too steep to measure

3^{49-} Shut Down



#383

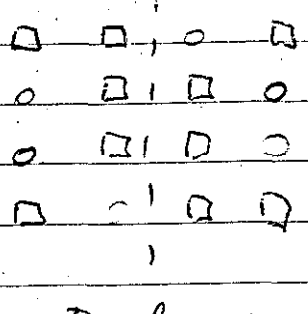
Remove 1ea 5 kg U(90)

Add 1ea 16. kg U(30)

Now 10ea 16kg U(30)

4ea 10kg U(90)

2ea 5kg U(90)



3^{57} Start Assembly

4^{06} Tables Closed .106 W .103 E

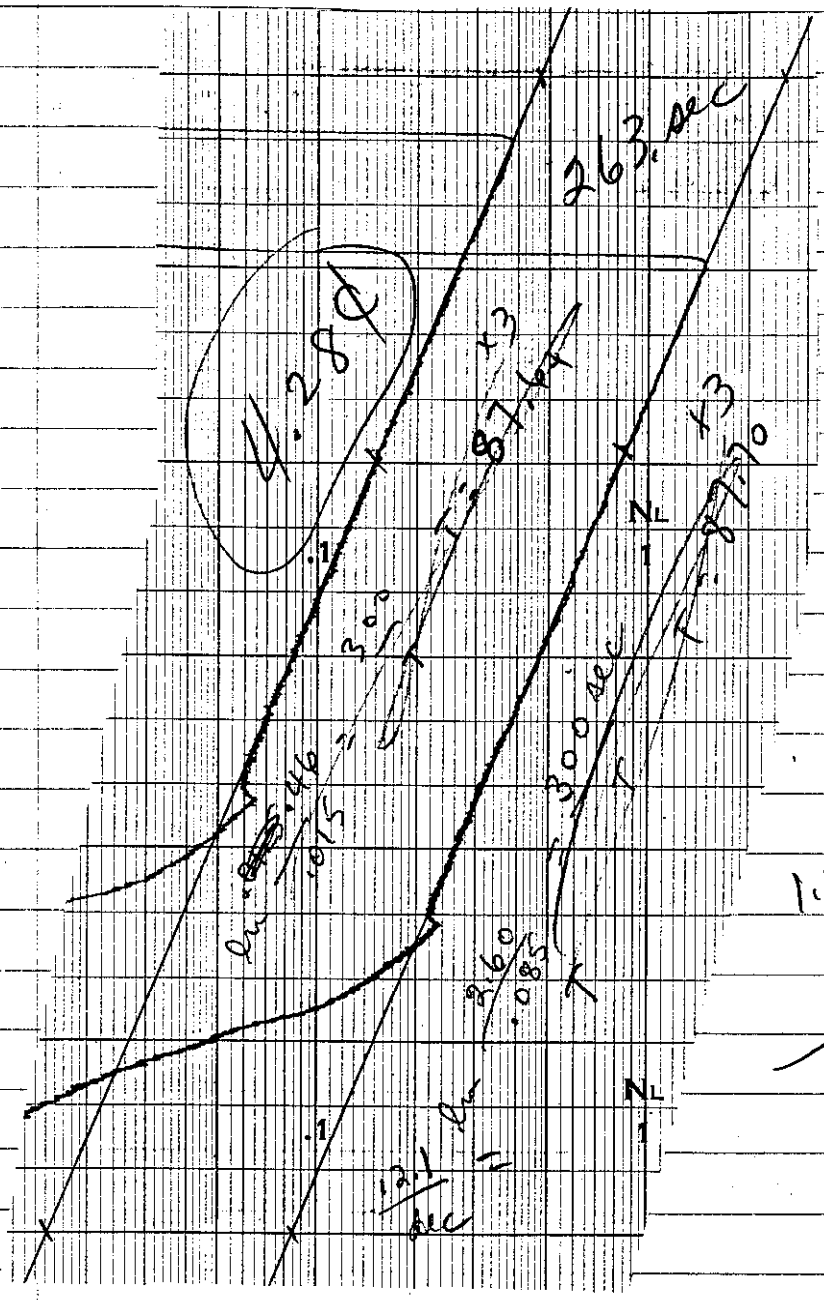
Power Rising with Source

$4^{05\frac{1}{2}}$ start (Super Crit) Pos Period

No.	2290	5.213
	2473	5.210
		10.423
	2190	10.443
	2193	10.473
	2195	10.483
	2196	10.479
		41.875

U(93)

Total 52.298

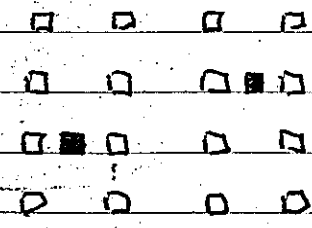


1.049
.0428
.00641
.000288

EXP #384 (Repeat #376)

4x4x4 array of U(30)

with 4ea CH_2 $(3.25)^3$



4:22 Start Assembly (No Source)

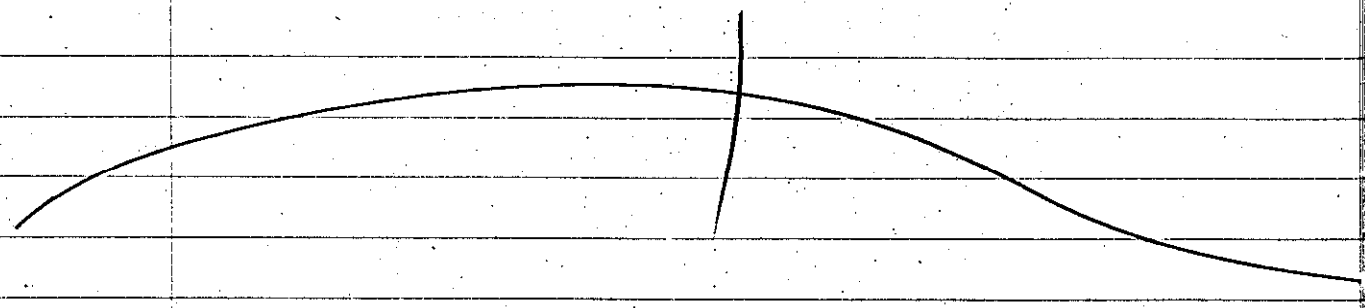
On Pos Period :10 W

:10 E

Tables Closed

Shut Down 4:28

Plane of separation looking North & South



Exp 385 U(30) (3¼" X 3¼" X x,y,z)
Solid Stack, on 6½" poly Base

Instrument Check on FEB 21 1973 Source 10 Mc 60Co

PM-1 875V Low Trip ok Trip ok

IC-1 3X10⁻¹⁰ mtr Trip ok Fast Trip ok
IC-2 3X10⁻¹⁰ mtr Trip Scramtables
IC-3 9X10⁻¹⁰ Calibration SWM
IC-4 9X10⁻¹⁰ Calibration ✓
Source M-230 in Red Lite CC

Rad. mon. Alarms
A - ok
B - ok
C - ok

N ← | E

Base blocks for alignment H = 3¼"

Moveable		Fixed
124	127	113
126	128	112
125	123	114

x = 3¼"

Bottom Reflector CH_2 6½ × 13 × 6½ W 6½ × 13 × 6½ in.

added on H = 6½" k < 1

115	120
117	118
116	119

129
122
121

x = 3¼"

H = 8¼" k < 1

020	017
023	019
021	018

015
022
016

y = 1"

024	025
027	026
030	029

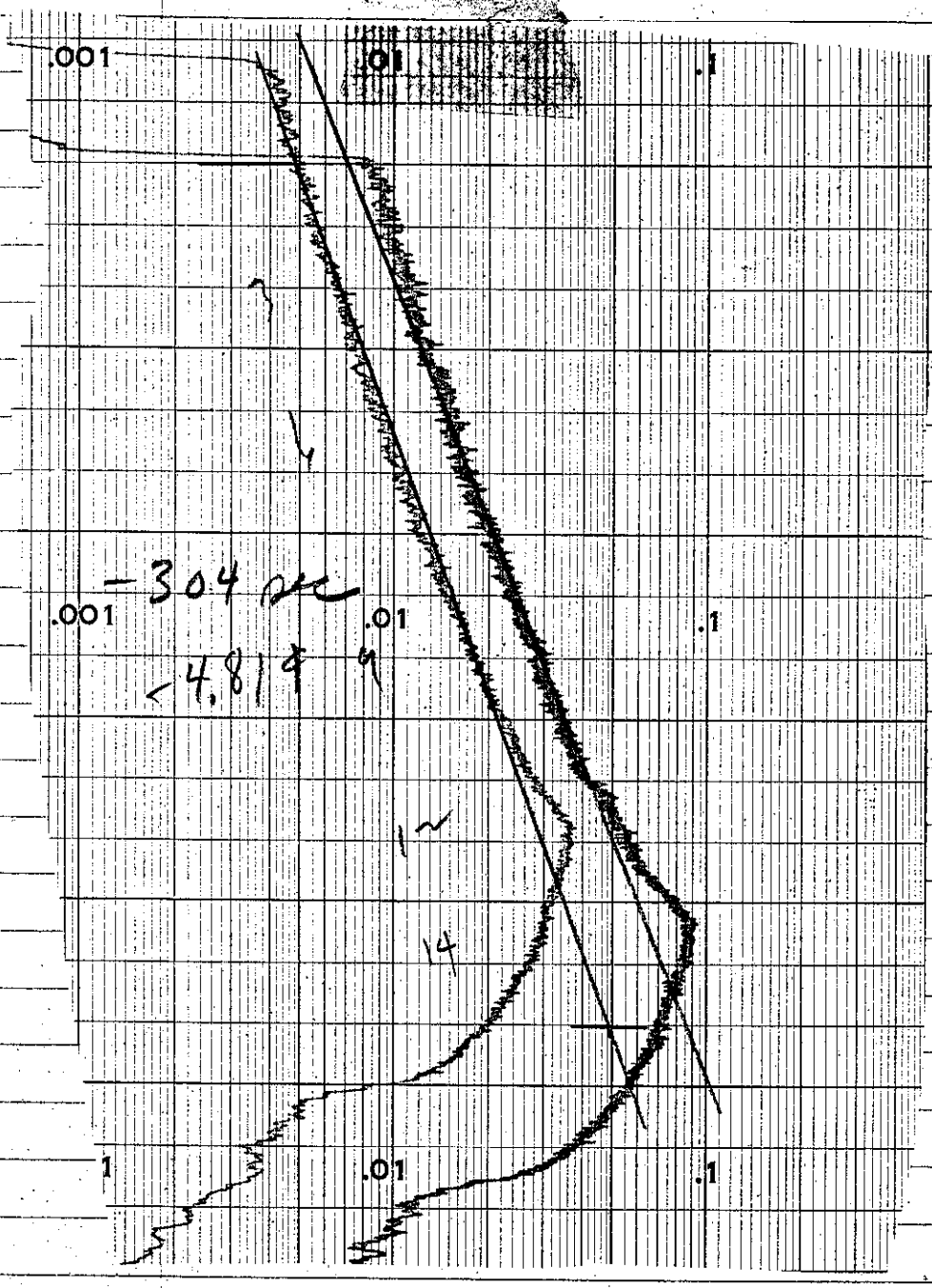
031
028
032

z = ¾"

Exp 386

Added 1/8" thickness to top. H = 8 3/8"

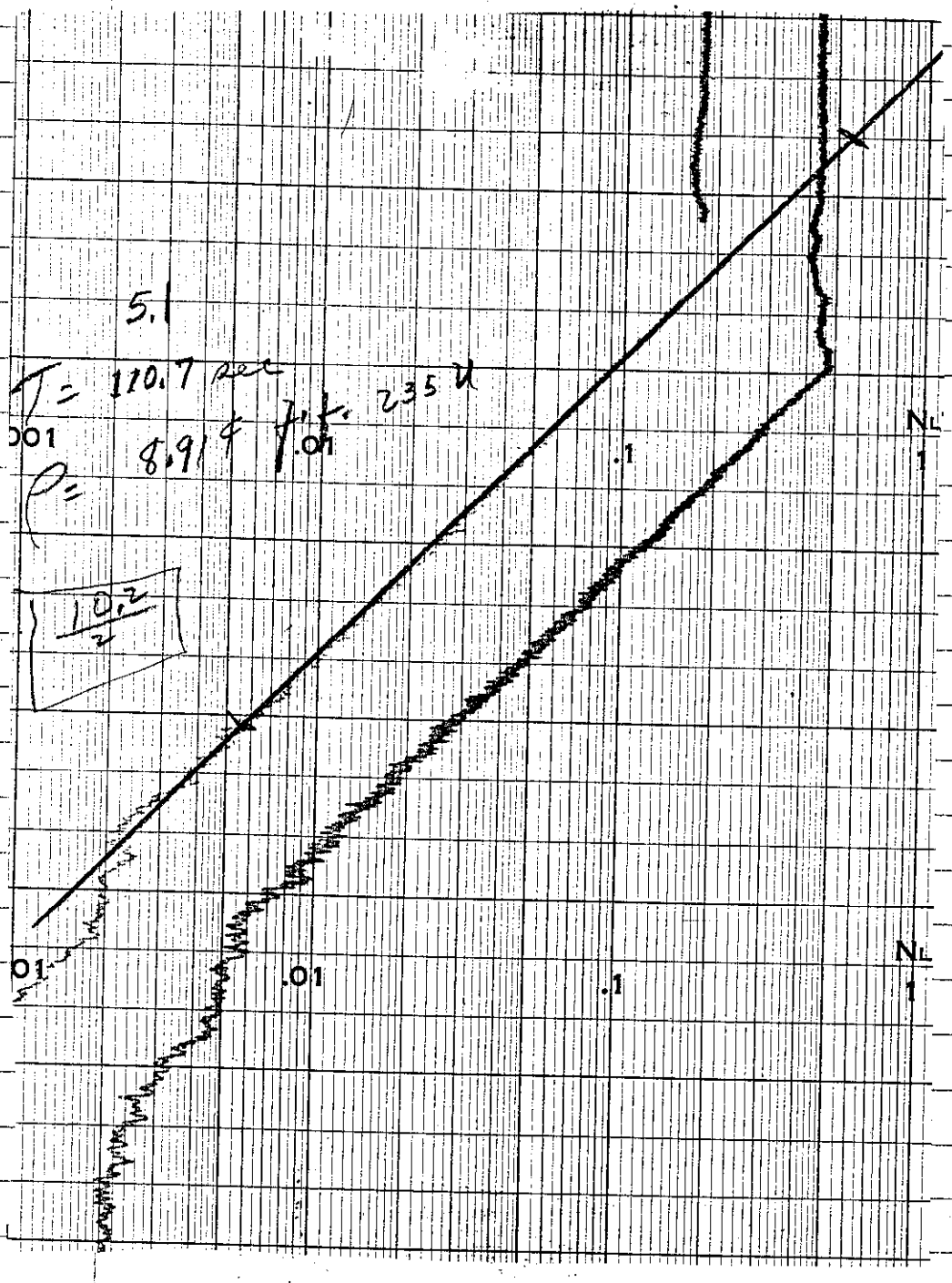
k < 1, ρ = − 4.81 ¢



See previous exp No 46.
−6.1 ¢

Reflector was on top exact size of assembly Uranium Metal on 1/8 Alum ¢ Boxes.

#47
+1.55 ¢


5.1
T = 110.7 sec
ρ = 8.91 ¢ f.f. 235 U
10.2/2
.001
.01
.1
NL
1
.01
.01
.1
NL
1

Instrument Check on 2-23-73 Source M-230

PM-1 _____ Low Trip OK Hi Trip OK

IC-1 3×10^{-10} Meter Trip OK Scram table Fast Trip OK

IC-2 3×10^{-10} Meter Trip OK

IC-3 Response OK Calibration

IC-4 Response OK Calibration

Red lite g.g.

Rad Monitor
A ✓
B ✓
C ✓

Source Response OK Pres. OK
Expr #1 387

U-30 Metal Blocks 9.75 x 9.75 x 8.375"
Reflected on Bottom by 6½" Polyethylene
Base 13.5" sq.
Add one Pc fuel to center Block
3¼ x 3¼ x ⅛" thick

9 33 start tables together
9 48 tables together Pos Per ρ = 8.91¢
9 58 Approx. level W. .116 E .119
level .117 .119
10 02 Shut Down Separate tables

Expr #1 387 - Run for Opr. test for C.C.