BOOK 121R

Notes:
on front (very faded): "CA-25" ?? "Book II"
on back: "SECRET" at top and bottom

Blank pages: page opposite page 1, 1-8, 84, 85, 204-300, inside page opposite 300

pages 34, 36, 38, 40, 42, 46, 51, 53, 67, 78, 82, 86, 93, 99, 102, 104, 107, 108, 112, 120, 121, 125, 128, 130, 133, 135, 162, & 172 each have one graph taped down

loose graph between pages 244 & 245

Scanned by:
Sheila Finch
RSICC /Oak Ridge National Lab.
May 17, 2001

SECRET

SOME INSTRUCTIONS FOR USE OF THIS NOTEBOOK

This notebook is assigned to personnel performing research and development work and must be used for all original calculations, notes and abstracts from reports.

Assignee is responsible for the safeguarding of this notebook in accordance with security regulations.

This notebook must be returned to issuing office whem completed or upon termination of assignee.

Every page or entry should bear a date and the signature of the person who made the entry.

Entries should be made in ink whenever it is reasonable to do so.

Alteration or amplification of entries made on previous dates should be made as separate entries under their own dates and cross referenced to the previous entries.

Charts, drawings and graphs drawn on special paper should be glued or otherwise securely fastened in place and should individually bear a date and signature. Do not obscure any information.

The notebook should be periodically reviewed by one or more independent persons in the department and should be signed and dated by them. Likewise, they should make a statement that they have "read and understood the foregoing material." Witnessing stamps for this purpose are available in your department's office.

It is advisable to preface each new item, such as a heat treatment, process or reaction, etc., with a very brief description of the purpose, objective or approach.

Description of the invention or discovery should be complete enough to be understood by anyone skilled in the art.

Reference to name or catalogue number should be made when standard items are being discussed, i.e., Westinghouse pump.

In cases where work is conducted in cooperation with others, it is often necessary to meet with them from time to time and discuss new developments. The occurences of such conferences should always be entered in your notebook regardless of recording elsewhere, giving the date, who was present (if possible), and an outline of the subjects discussed. This often will establish error in occasional claims of other parties that you have appropriated information from them revealed during an interview, and thus provide you with patent protection.

SECRET

~~SECRET~~

C-15

OAK RIDGE NATIONAL LABORATORY

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Inv 67

UCC

POST OFFICE BOX P

OAK RIDGE, TENNESSEE

This document consists of 1 / 1 / 1 / 360 pages. No. 1 of 1 copies, Series A

NOTEBOOK NO. 5054

Assigned to: A. D Callihan

Department: Applied Nuclear Physics

Location: Bldg 9213 4-12

Date: Oct 19, 1955

This notebook is assigned to personnel performing research and development work and must be used for all original calculations, notes and abstracts from reports.

Assignee is responsible for the safe-guarding of this notebook in accordance with security regulations.

Inv 59 Aug

Do not use scrap paper.

Be sure to record all personal conferences.

This notebook must be returned to Laboratory Records-Bldg. 4500 when completed or upon termination of assignee.

Subject

Page

This document consists of 300 pages. No. 1 of 1 copies, Series A

CLASSIFICATION CANCELLED

DATE 6/3/60

For the Atomic Energy Commission:

[illegible] for the Chief, Declassification Branch

Continued from page 159, APPR Notebook #2 (#5055)

10

Expr. #9-9 Time 9:45 Date 1-9 1956

Purpose Zero chut.

Personnel:

INSTRUMENT CHECK

Date ____ 195__ Time ____ AM PM Source No. ____

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	80	10 x 20 / 12in	3"
Log N	✓			
R-1	✓	4.8	.8 x 1000 x 100	1"
R-2				
P. M.	✓		800V	1"

Log N calibration — 0.055

START-UP CHECK LIST

Equipment Checked by JL+MB Instrument by RJ mB+RJ

Instrument

"Source In RS

Emergency MB

Red Light (...) MB

Start-Up OK'd by RJ 9:45 Date 1-9 1956

Loading —

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	13	3	"B"	4	6	5	12	"B"	7	9			"B"	14	8	2	10
material	f	f	f	B	f	f	f½	f	B	f	f			f	B	f	f	f	f

box 23	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series 11 →	13	14	15	B	17	18	5/23	19	B	21	25	27	23	B	28	29	30	31
box 16 → 33	1	2	B	3	4	5/16	5	B	6	7	8	16	B	(*)	10	11	12	

f

	slot 12	slot 13		slot 12	slot 13		slot 12	slot 13
1	1-9*	1-16A	16	11-8	11-16	34	15-4	14-23
2	4-2	2-16	17	15-17	3-23	32	5	11-32
3	6-32	3-16	18	15-18	4-23	33	6	1-17*
4	6-40	4-16	19	1-19	6-23	34	7	11-34
5	1-11	6-16	20	H-961	11-20	35	8	11-35
6	2-12	7-16	21	4-20	7-23	36	9.5	11-36
7	#259	8-16	22	11-27	11-22	37	A-506	11-37
8	511	9-16	23	#328	11-23	38	4-27*	11-31
9	15-9	10-16	24	H-959	11-24	39	A-505	11-39
10	512	12-11	25	5-41	8-23	40	5.15	11-40
11	5-11	13-16	26	#A-264	11-26	41	4-3	512
12	15-12	14-16	27	15-1	9-23	42	1-15	11-42
13	-13	15-16	28		10-23	43	7-3	617
14	-14	1-23	29	15-2	12-23	44	15-10	11-44
15	-15	2-23	30	15-3	13-23	45	4-9	618

Reactor super critical by about 3¢ (400 sec period)
= Rod + blade in, water up, source out. Log N = 0.2.

Will pull one full fuel plate for foil exposure.

Log N recorder is not standardizing itself properly. Must be done manually. After doing this, log N calibrated with source at 0.07. (Difference may be due to higher background and/or standardization)

12

Expr. 19-20 Time 11:30 (AM) PM Date 1-9 1956

Purpose Bare gold flux distribution in reflector with boron – also fine structure in

Personnel:

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by JL

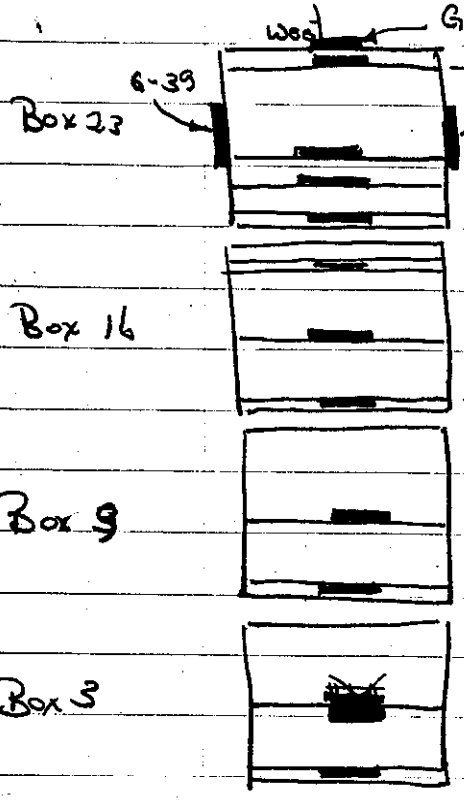
Instrument and Safeties Checked and Reset by RJ

"Source In" Checked by RJ Source No.

Emergency Equipment in Control Room Checked by MB

Red Light On by JL

Start Up OK'd by RJ Time 11:30 (AM) PM Date 1-9 1956



— slot 17, normalizing foil # N-38

— slot 6, foil G-64

— slot 4, foil G-61

— slot 1, foil G-37

— slot 16 foil G-66

— slot 15

— slot 6, foil G-62

— slot 1, foil G-53 57

— slot 6, foil G-65

— slot 1, foil G-56

— slot 6, foil G-34 (foil [redacted] in toward center)

— slot 1, foil G-40

1" G-32

2" - 59

3" - 44

4" - 31

5" - 43

6" - 63

7" - 58

Fuel loading - same as 19-9 except fuel plate 4-27* replaced by S.S in slot 12, box 38.

Top End boxes off.

We find power at 11:45:40.

Run conditions.

Rod	12.8	DC-2	83 (10×10)
Blade	3.42	R-1	—
Water	109.2	Log N	2.0

No water temperature because of no ice

20 minute exposure.

Expr. 19-11 Time 310 AM Date 9 Jan 1956
Purpose Cd Covered Au Flux + fine structure

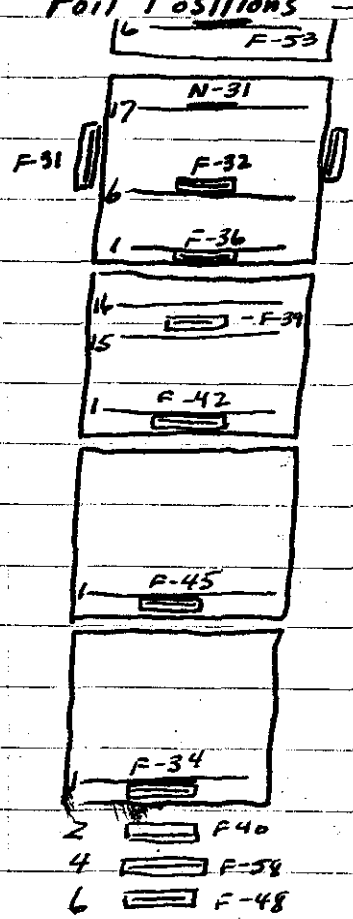
Personnel: JL, RS

START UP CHECK LIST

Equipment Checked by JL Checked by RS
Instruments [illegible] JL
"Source In" [illegible] RS
Emergency [illegible] RS
Red Light On by JL
Start-Up OK'd by RS Time 310 AM Date 9 Jan 1956

Loading : Same as 9-11

Foil Positions → North



Box		SLOT	SIDE	FOIL
23		ON BOX	SOUTH	F-31 cd
23		"	NORTH	F-49 cd
Box 23	NORM 23	17	OUT	N-31 BARE
	23	6	IN	F-32 cd
Box 16	23	1	OUT	F-36 cd
	16	15-16	BETWEEN	F-39 cd
	16	1	OUT	F-42 cd
Box 9	9	1	OUT	F-45 cd
	3	1	OUT	F-34 cd
	NORM 30	6	OUT	F-53 BARE
Box 3	REF	2		F-40 cd
		4		F-58 cd
		6		F-48 cd

WATER HT 109. WATER TEMP

LOG N 2 DC-3 83 (10X10)

BLADE POSITION 7.4 ROD POSITION 29.02

TIME RUN STARTED 3:31:22 PM

" " STOPPED 3:51:22

16

Expr. 19-12 Time 11:00 AM PM Date 1-10 1956

Purpose Flux run with boron-ed covered gold - Part II

Personnel:

INSTRUMENT CHECK

Date FIO 1956 Time 11:06 AM PM Source No.

Instrument	Trip Reading	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	80	10×20	
Log N	✓		12 cm	
R-1	✓	5	.8×1000 ×100	2.
R-2				
P. M.	✓		contact	

START-UP CHECK LIST

Equipment Checked by DWM Personnel Check by DWM

Instrument [illegible] by DWM

Source In [illegible] MB Source No.

Emergency [illegible] Room Checked by DWM

Red Light On by DWM

Start Up O.K.'d by MB Time 11:20 A.M. ~~P.M.~~ Date JAN 10 1956

Loading: Same as 19-11.

FOIL POSITIONS

Box 23	Outside (west) Near Box 30.		F-52	Cd Covered
Box 23	Slot 4	(Boron Plate)	F-47	" "
Box 23	Slot 17	(11-30)	N-36	Bare
Box 30	Slot 6.	(6-30)	F-41	"
" 16	" 6	(11-4)	F-51	Cd Covered
~~X~~9	6	(6-9)	F-57	" "
X3	6	(6-3)	F-37	" "
X Reflector	1"		F-50	
	3"		F-38	
	5"		F-33	
	7"		F-44	

11:42':31" Start 5:1 Run

12:03':31" Scram (21' Run)

Water Ht 109.5 DC-3 Sat.

Temp 68.5 R-1 Off Scale

Log N [redacted] DC-2 x1 x100

Cont. Rod 29.02"

Cont. Blade 10.14"

UO_2F_2 Solution Analysis

Anal. Chem Reg # 984626 →

for APPR high U density

homogeneous Fuel Element

0.17432 gm U/gm

93.22

Weighed has 3603 gm soln

628 gm U

14.5 x 33.4 = 484.3 g U loading of APPR Crit Exp.

∴ 484.3 x .9312 = 451.0 g U-235

0.17432 x .9322 = 0.16250 g U-235/gm soln

Required solution to equal 14½ Crit Exp loading

∴ $\frac{451.0}{.1625}$ = 2775.4 g soln

OHAUS

Wt of Fuel Element (Empty) 5248 g

8022

2774

Solution Bottle

Gross Wt with Top 5561 g

Net WT with Top 2785

2776.

weight of U-235

0.1625 x 2772.53 = 450.54

KdlHandsh

Beaker Tare Wt 316.6

Wet	tare	443.78	
graduate	tare	443.30	
#1	gross	1038.63	
	vol 476cc	~~595.33~~	594.85
#2	gross	1030.90	
	vol 470 cc	~~587.60~~	587.12
#3	gross	1032.16	
	vol 472	~~588.86~~	588.38
#4	gross	1028.51	
	vol 469	~~585.21~~	584.73
	1887	~~2357.00~~	
	Sp grav = 1.249		2775.4
			2357.0
			418.4 g needed
#5	gross	861.23	or 335 cc
	vol 335	~~417.95~~	417.45
		2774.93	2772.53

20

Expr. 20-1 Time 9:15 (AM) PM Date 1-11 1956

Purpose Zero run — Homogenious element. in boron loaded core.

Personnel:

INSTRUMENT CHECK

Date ____ 195__ Time ____ AM PM Source No. ____

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	80	10V20	
Log N	✓	4.4	12cm 8V1000	
R-1				
R-2				
P. M.	✓		800V	

START-UP CHECK-LIST

Equipment Checked by DM Personnel Check by DM

Instrument and Safety Rods Checked and Reset by MB+DM

"Source In" Checked by DM Source No. ____

Emergency Equipment in Control Room Checked by MB

Red Light On by MB

Start-Up OK'd by DM Time 9:25 (AM) PM Date 1-11 1956

Loading:

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	1	13	3	"B"	4	6	5	12	"B"	7	9			"B"	14	8	2	10
	f	f	f	B	f	f	f	f	B	f	f			f	B	f	f	f

for boxes 23 & 16 see page 10.

All boron in box 23 replaced by S.S.

	slot 12	slot 13		slot 12	slot 13		slot 12	slot 13
1	1-9*	1-16A	16	11-8	11-16	31	15-4	14-23
2	4-2	2-16	17	15-17	3-23	32	S.S.	11-32
3	6-32	3-16	18	S.S.	4-23	33	15-6	1-17*
4	6-40	4-16	19	1-19	6-23	34	-7	11-34
5	1-11	6-16	20	1-16	11-20	35	-8	11-35
6	2-12	7-16	21	505	7-23	36	S.S.	11-36
7	#259	8-16	22	4-20	11-22	37	510	11-37
8	S.S.	9-16	23	11-27	-23	38	S.S.	11-31
9	15-9	10-16	24	#378	-24	39	515	11-39
10	S.S.	12-16	25	506	8-23	40	15-1	-40
11	15-11	13-16	26	3-41	11-26	41	15-5	-41
12	-12	14-16	27	A-264	9-23	42	1-15	-42
13	-13	15-16	28	S.S.	10-23	43	15-14	-43
14	S.S.	1-23	29	15-2	12-23	44	15-10	-44
15	-15	2-23	30	15-3	13-23	45	15-16	-45

1.1718

8.210

f.f.f

Reactor too reactive - critical conditions

water height 87.5 cm.

blade in, rod out

Log N 0.15.

R-1 3.1 (100 x 1000)

22

Expr. 20-2 Time 10:00 (AM) PM Date 1-11 195

Purpose Zero run.

Personnel:

INSTRUMENT CHECK

Date 195 Time AM PM Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3				
Log N				
R-1				
R-2				
P. M.				

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by Dm

Instrument and Safety Checked and Reset by Dm

Source Interlock Checked by Dm

Emergency Equipment and Control Room by MB

Red Light On by MB

Start-Up OK'd by Dm Time 10:20 PM Date 1-11 1956

Loading: same as 20-1 except for the following exchanges in slot 12.

now in box	instead of
15-1	18 5.5.
15-12	32 5S.
2-12	14 5.5.
1-16	28 5.5.
5.5.	6 2.12
"	12 15-12
"	20 1-11
"	22 4-20
"	24 #328
"	26 311
"	34 15-7
"	40 15-1

Loading change from 20-1 is four full fuel plates

Still too reactive. - critical conditions:

water height = 88.1 cm.

R-1	6 (50 x 1000)
Log N	0.13
	1

24

Expr. 20-3 Time 10:25 (AM) PM Date 1-11 1956
Purpose Zero run.

Personnel:

START-UP CHECK LIST

Equipment Checked by DM Personnel Check by DM DM
Instrument and Safeties Checked and Reset by
"Source In" Ch... DM
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DM Time 10:25 (AM) PM Date 1-11 1956

Loading- same as 20-~~1~~ except S.S. is now in the following boxes instead of Pu-Be (slot 12)

3, 6, 12, ~~[illegible]~~ 20, 26, 34, ~~40~~ 40, 43, 22, 24

(there now are a total of ~~18~~ 18 S.S. plates in ~~the reactor~~ slot 12)

still to be rewrite:

water 90.5

$\log N$ 0.2

R-1 4.5 (10x1000)

Rod out, blade in, source out.

Expr. 20-4 Time 10:55 (AM) PM Date 1-11 195 6
Purpose Zero run.

Personnel:

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by MB
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DM Time AM PM Date 195

Loading - same as 20-1 except s.s is now in slot 12 of the following boxes:

1, 3, 5, 12, 16, 20, 26, 30, 34, 40, 41, 43, 45, 22, 24, 6

(there now is a complete check on board of 25 s.s. plates in slot 12.)

Critical at water height of 95.6 cm. (Log N = 0.15)
Inserted rod: critical water height 99.0 cm.
Blade in.

Water temp.: 71°F.

Expr. 20-5 Time 11:25 (AM) Date 1-11 1956
Purpose Zero Run.

Personnel:

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by DM
Instrument [illegible] DM
"Source In" Checked by DM [illegible] No
Emergency Equipment & Control Room [illegible] by MB
Red Light On by MB
Start-Up OK'd by DM Time 11:25 (PM) Date 1-11 1956

Loading - same as 20-4 except s.s. is now in slot 12 in the following boxes:
9, 21, 25, 37.
(now a total of 28 s.s. plates in slot 12)

Water Ht 109.5 Sub Critical 1000 - 400 sec
Blade Out. period.
Rod 29.02

Expr. 20-6 Time 12:40 PM Date JAN 11 1956
Purpose Zero Run
3 Boron Removed from 23
Personnel: DwDn MB

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by DwDn
Instrument and Safeties Checked and Reset by DwDn MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by DwDn
Red Light On by MB
Start-Up OK'd by MB Time 12:40 PM Date JAN 11 1956

Loading: Exp.(20-4) + #959 in Box 9 Slot 12.

Total plates 11 x 45 = 495 - 28 = 467 g

half plates 46 ~~467~~ 23 Total

Total ~~630 x 3113 = 196~~ kg

see Subcritical Period > 400 T = 73.5°F

28

Expr. 20-7 Time 1315 ~~PM~~ JAN 11 1956
Purpose Zero RUN
3 - BORON REMOVED FROM
23
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by DWM
Instrument and Safeties Checked and Reset MB
"Source In" Checked by MB Film No.
Emergency Equipment in Control Room checked by DWM
Red Light On by DWM
Start Up OK'd by MB Time 1315 PM Date JAN 11 1956

LOADING : Exp 20-6 plus #-958 in Box 37 Slot 12
~~6 Plates~~ Plates → -28

Water Kt 109.5 log N ~ 1
" Temp 73 °F (-400 sec)
Rm Temp ~76.5 Subcritical
Blade 28.30
Rod 29.02

SUB CRITICAL

Expr. 20-8 Time 1335 ~~AM~~ PM Date JAN 11 1956
Purpose ZERO RUN
3 BORON REMOVED
FROM 23
Personnel: AWM MB

START-UP CHECK LIST
Equipment Checked by AWM Personnel Check by AWM
Instrument and Switches Checked and Tested by AWM
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by AWM
Red Light On by V
Start Up OK'd by MB Time 13 35 AM PM Date JAN 11 1956

1 12

LOADING: EXP 20-7 PLUS H-951 Box 21 Slot 12
H-961 Box 25 Slot 12
~~63 Hz~~ plates in Core. was

CRITICAL CONDITIONS:

Control Blade	16.09	Log N	0.19
" Rod	29.02	R-1	5.9 x 100 x 1000
Water Height	109.7 cm	DC-3	755 x 10 x 20
" Temp (C)	73		
Room Temp. (F)	76		

TIME		BLADE POSITION		
13:46	1:46 PM	16.09	6 ¢	Before
15:30	3:30 PM	28.30	-1.45 ¢	After
			7.45 ¢	drift

1-12-56
after finding error in loading: this error in loading amounts to 4.33 ¢ using runs 20-16 & 20-13 together with the c.c.c. blade calibration curve & the ~~factor 1.076~~ 1.01. (see pg 48)
∴ Zero drift is closer to 3.1 ¢.

30

Expr. 20-9 Time 13 53 AM PM Date JAN 11 1956

Purpose HOMOGENEOUS ELEMENT

Personnel: DWM MB

START-UP CHECK LIST

Equipment Checked by DWM Personnel Check by DWM

Instrument and Safeties Checked and Reset by MB

~~"Source In" Checked by~~ MB Source No.

Emergency Equipment in Control Room Checked by DWM

~~Red Light On by~~ ✓

~~Start-Up OK'd by~~ MB Time 13 53 AM PM Date JAN 11 1956

LOADING: SUBSTITUTED HOMOGENEOUS ELEMENT FOR BOX 23.

CRITICAL COND.

BLADE	0.01	Log N	.12
ROD	29.02	R-1	5.7 x 50 x 1000
WATER HT.	91.0	DC-3	47 x 10 x 10
Temp	73		

Expr. 20-10 Time 2227 (PM) Date 1-11 1956
Purpose Homogenious element in box 23.

Personnel:

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by MB
~~Instrument and Safeties Checked and Reset by~~ DM
"Source In" Checked by DM Source No.
~~Emergency Equipment in Control Room Checked by~~ MB
Red Light On by MB
~~Start Up OK'd by~~ DM Time 2:27 AM (PM) Date 1-11 1956

Loading - same as 20-9 except for the following substitutions: in all cases S.S. is inserted into slot 12 in place of fuel.

box	fuel removed:
9	H-959
15	15-15
17	15-17
21	H-951
25	H-961
29	15-2
31	15-4
37	H-958

Reactor sub-critical
Bluhet Rod out, water up
temp. 73°

32

Expr. 20-11 Time 3:45 (PM) Date 1-11 1956
Purpose Homogeneous box 1 to 23.

Personnel:

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by MB
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DM Time 2:15 (AM) (PM) Date 1-11 1956

Loading - same as 20-9 except: S.S. inserted into the following boxes in slot 12

box	fuel removed
15	15-15
17	15-17
29	15-2
31	15-4

Critical conditions -

$Log_8 N$	0.2	Water	106.4
DC-3	76 (10x20)	Blanks	14.55
R-1	5.5 (100x100)	Rod	29.02
		Temp	72.5

Est Time Crit 3 PM

Note: In this Run Half Fuel Plate H-951 was in slot 12 Box 20 Rather than in Slot 12 Box 21 as in Exp. # 20-9.

WKJ. 12 Jan 1956

Expr. 20-12 Time 3:15 AM (PM) Date 1-11 1956
Purpose Re-run zero.

Personnel:

START-UP CHECK LIST

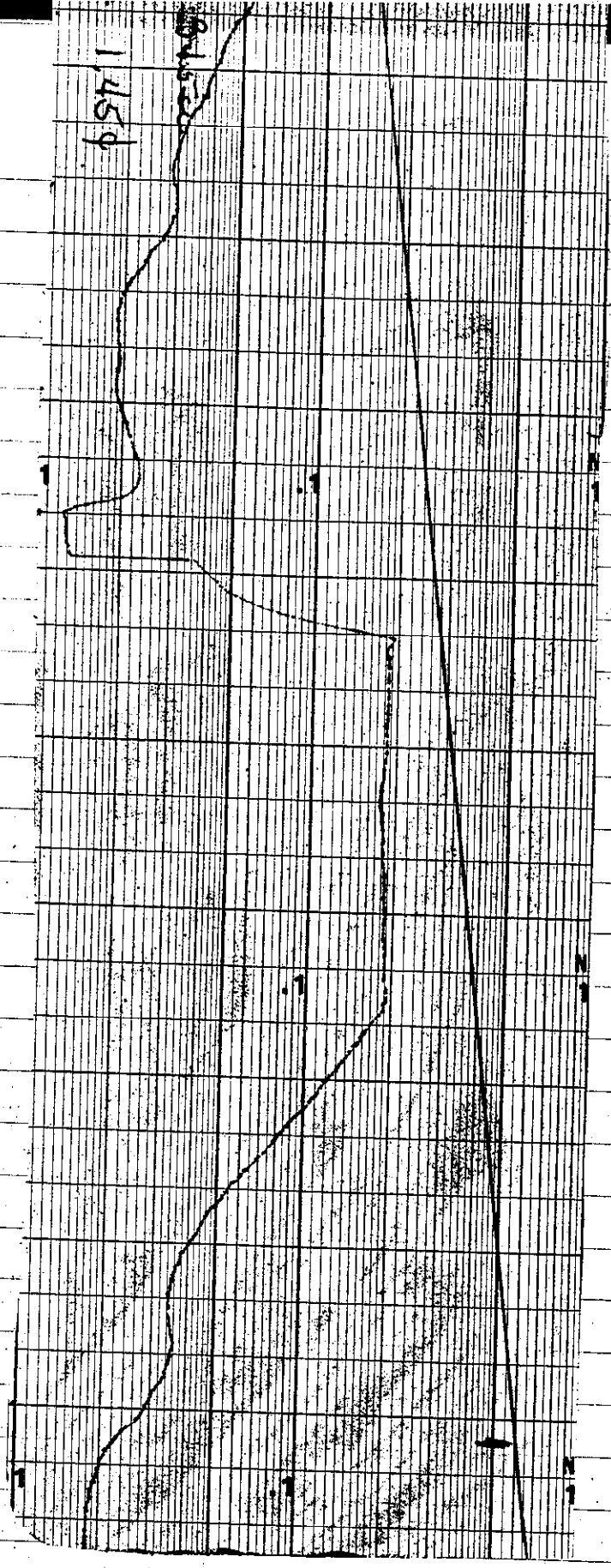
Equipment Checked by DM Personnel Check by MB
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start Up OK'd by DM Time 3:15 AM (PM) Date 1-11 1956

Loading - same as 20-9

Not quite critical -
Height 109.4
Temp. 72.5 Rm. Temp. 74.
Log N ~~0.10~~ ~0.10 (max 1.3)
DC-3 70 (10x10)
R-1 3.5 (100x100)
~~Rod~~ Blade 28.30
Rod 29.02
Source out.
Negative period taken to measure the reactivity of the reactor.
Time 3:30.

Period measured on Log N was 43.5 div. = 945 sec
or 1.45 ¢.

43.5 Div
Decade
1.45 g


1
1
N
1
1
N
1
1
N
1

Expt. 20-13 Time 8:30 AM PM Date 1-12 195 6

Purpose Zero Run for Evaluation of Exhibit Fuel.

Personnel: MB, JL, WRS

INSTRUMENT CHECK

Date 195 Time AM PM Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	~	80	20×20	
Log N	~		12 in	
R-1	~	6.7	1000× 1.0	
R-2				
P. M.	~		806V	

Log N calibration - 0.073

START-UP CHECK-LIST

Equipment Checked by MB Personnel Check by RJ

Instrument and Safeties Checked and Reset by MB

Source In" Checked by MB Source No.

Emergency Equipment in Control Room Checked by RJ

Red Light On by RJ

Start-Up OK'd by MB Time 855 AM PM Date 13 Jan 195 6

Loading: Same as 20-8, except that Full Fuel plates were added to 5 Boxes in slot 12, replacing Stainless steel.

Slot 12 Box	Fuel Plate #
1	1-11
3	15-8
5	15-5
20	15-3
26	11-8

This fuel was added in order to make the assembly critical with the Control Blade full in, prior to

making a fuel evaluation of those plates removed to compensate for the addition of the Homogeneous Element (Exp. 20-11).

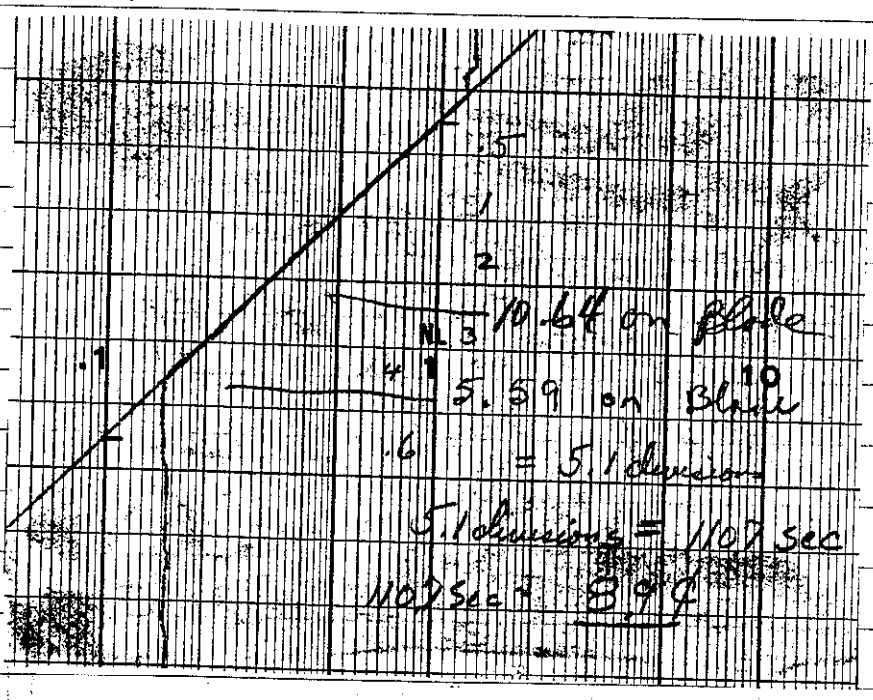
Critical Conditions:

Log N - .16	Control Blade 5.59
DC-3 - 65x20x10	Control Rod 29.02
R-1 - 4.5x100x1000	Water Ht. 109.6

Water Temp - 74°

Blade Pulled to 10.64 to measure a positive period for Blade Calibration point.

The Blade from 5.59 to 10.64 was worth 8.9¢.



Expr. 20-14 Time 940 (AM) PM Date 12 Jan 1956
Purpose Fuel evaluation -of Plate 15-17

Personnel: MB WRS

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
Source-In Checked by MB Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ
Start-Up OK'd by MB Time 940 (AM) PM Date 12 Jan 1956

Loading: Same as 20-13, except plate 15-17 was pulled from slot 12- Box 17 for evaluation.

Critical Conditions:

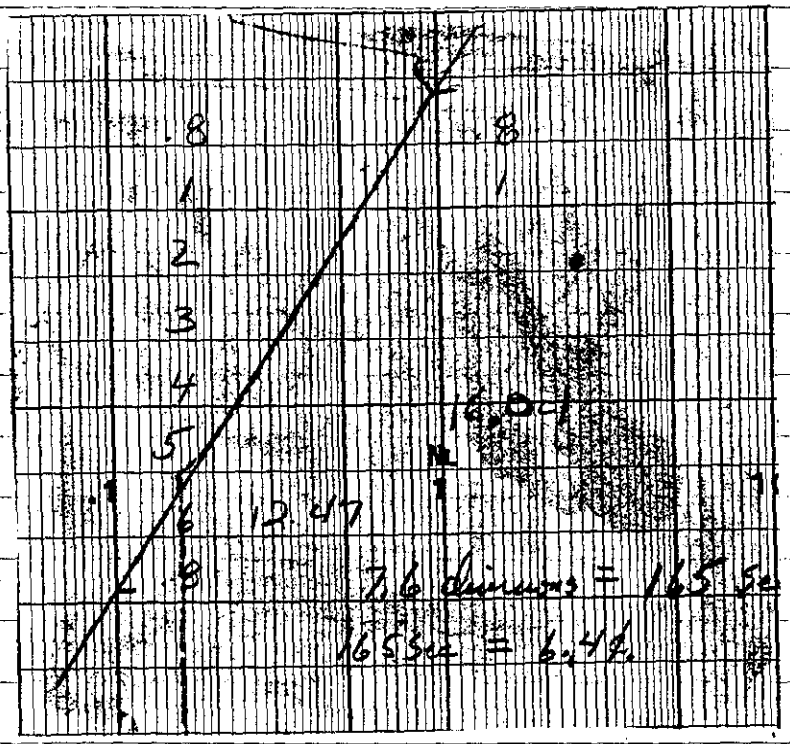
Log N	.16	Control Blade	12.47
DC-3	65 110 120	Control Rod	29.02
R-1	4.6 1100 1100	Water Ht.	109.6
Water Temp	74°		

Fuel Plate 15-17, Slot 12 Box 17. is worth from 5.59 to 12.47 on the Control Blade

The blade was pulled from 12.47 to 16.04 to get another Calibration point.

The Blade from 12.47 to 16.04 was worth 6.44.

(Curve on next Page)


8
8
1
2
3
4
5
6
16.0 cm
12.47
7.6 diameters = 165.5 cm
165.5 cm = 6.4 ft.

Expr. 20-15 Time 10:10 (RW) PM Date 12 Jan 1956
Purpose Fuel Evaluation - of Plate 15-4
Box 31 slot 12.
Personnel: MB WRJ JL

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
Source In Checked by MB Source No.
Emergency Equipment in Control Room Checked by RS
Rec Light On by RS 1010 (M)
Start-Up OK'd by MB Time 10 PM Date 12 Jan 1956

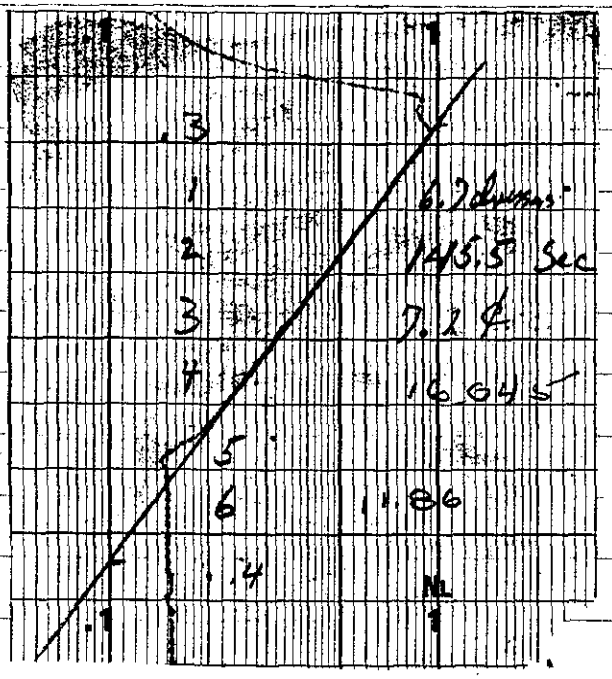
Loading: Same as 20-13, except that plate 15-4 was pulled from Slot 12 - Box 31 for evaluation.

Critical Conditions:

Log N	.155	Control Blade	11.86
DC-3	6.5 X10 X20	Control Rod	29.02
R-1	4.5 X100 X1000	Water Ht	109.5
Water Temp	74°		

Fuel Plate 15-4, Slot 12, Box 31 is worth from 5.59 & 11.86 on the Control Blade.
~~Blade~~

The control Blade is pulled from 11.86 to 16.04 to get another point on the control Blade Curve.
The Blade from 11.87 to 16.04 is worth 7.24
(Curve on Next Page)


1
.3
1
2
3
4
5
6
.4
.1
6.7 Volumes
1435.5 Sec
7.2 ft
16,645
1.06
NL

Expr. 20-16 Time 10:30 (PM) Date 12 Jan 1956
Purpose Zero for evaluation of ½ plate moved from Box 21 slot 12 to Box 20, Slot 12
Personnel: MB RJ

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by RJ
Source In? Checked by MB Source No.
Emergency Equipment in Control Room Checked by RJ
Red light On by RJ
Start Up OK'd by MB Time 10:30 (AM) Date 12 Jan 1956

Loading: Same as 20-13, except fuel plate 15-3 was moved to Slot 12 Box 43, ~~instead~~ From Box 20 slot 12.

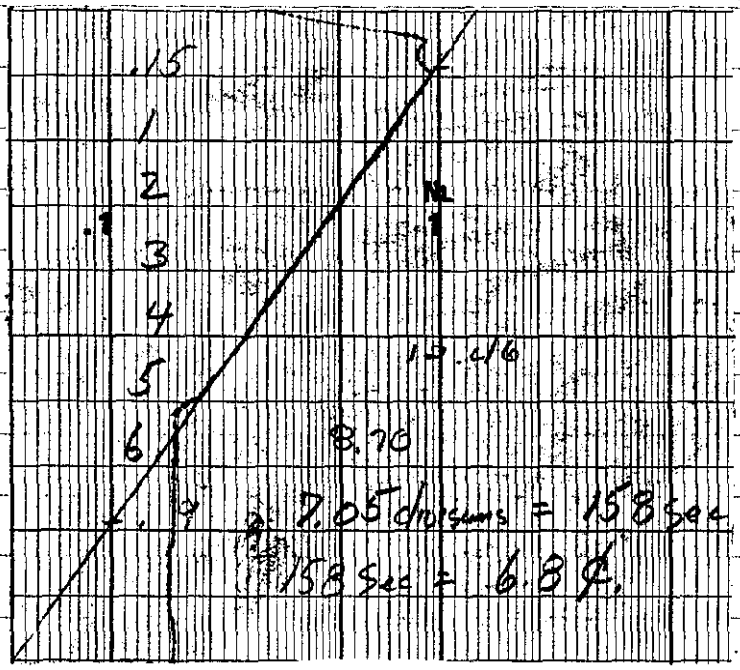
Critical Conditions

Log N .15	Control Blade 8.70
DC3 6.6 X10 X20	Control Rod 29.02
R-1 4.5 X10X1000	Water Ht. 109.4
Water Temp 74°	

The purpose of this run and the next is to evaluate the shifting of a ½ fuel plate from Box 21 to Box 20. in slot 12.

In Exp 20-8 Box 21 slot 12 had a ½ plate, Box 20 stot 12 had a steel. Through an error, in the Homogeneous demand evaluation run Box 20 slot 12 had the ½ plate, and Box 21 slot 12 had steel. This interchange should have the effect of making the reactor less reactive.

The Control Blade was pulled from 8.70 to 12.47 for another calibration point.
The Blade from 8.70 to 12.47 is worth 6.8¢



Expr. 20-17 Time 10:55 (AM) PM Date 12 Jan 1956
Purpose Evaluation of ½ plate shift from Box 20, to Box 21, Slot 12
Personnel: MB

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RJ
Start-Up OK'd by MB Time 1055 (AM) PM Date 12 Jan 1956

Loading: Same as 20-16 except that fuel ½ plate H 951 was shifted from Box 21 to Box 20 slot 12

Critical Conditions

Log N .155	Control Blade 10.70
DC-3 6.5 X10X ED	Control Rod 29.02
R.-1 4.45 X100 X100	Water Ht. 109.9
Water Temp 74°	

The interchange of the ½ plate between Box 20 & 21 ~~to~~ Slot 12 was worth from 8.70 to 10.70

Expr. 20-18 Time 11.25 12 Jan 1956
Purpose Recheck Zero of 20-13

Personnel: MB RS

Equipment Checked by MB Check by MB
Instrument and [illegible] MB
Source In [illegible] MB
Emergency [illegible] RS
Red Light On by RS
Start-Up OK'd by MB Time 11.25 Date 12 Jan 1956

Loading: Same as 20-13.

Note – mistake was found in this loading – plate 15-4 was in box 32 instead of 31. This is therefore not a zero check.

Critical Conditions.

Log N	.16 #F	Control Blade	9.98
DC-3	6.5 X 10 X 20	Control Rod	29.02
R.I	4.5 X 100 X 1000	Water At	109.6
Water Temp	74°		

We will assume the zero has not shifted since the difference of blade in this run & 20-13 can easily be explained by the mistake in loading. (This mistake was made between runs 15-K16 but will not effect runs 16 & 17.)

Expr. 20-19 Time 12:40 (AM) PM Date 1-12 1956
Purpose Zero point with boron removed from box 37
Personnel:

START-UP CHECK LIST
Equipment Checked by RJ+MB Personnel Check by RJ
Instrument and Safeties Checked and Reset by RJ
"Source in" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 1:40 (AM) PM Date 1-12 1956

Loading - exactly the same as 20-2 (page 22) except boron removed from box 37 instead of box 23.
(There are a total of 12 s.s. in slot 12)

Critical Conditions

logN	0.17	Blade	0.00
DC-3	64 (10x20)	Rod	17.49
R-1	47 (100x1000)	Water height	109.4 cm
Temp	74°F		

Expr. 20-20 Time 2:00 (AM) (PM) Date 1-12 1956
Purpose Zero run - box 37.

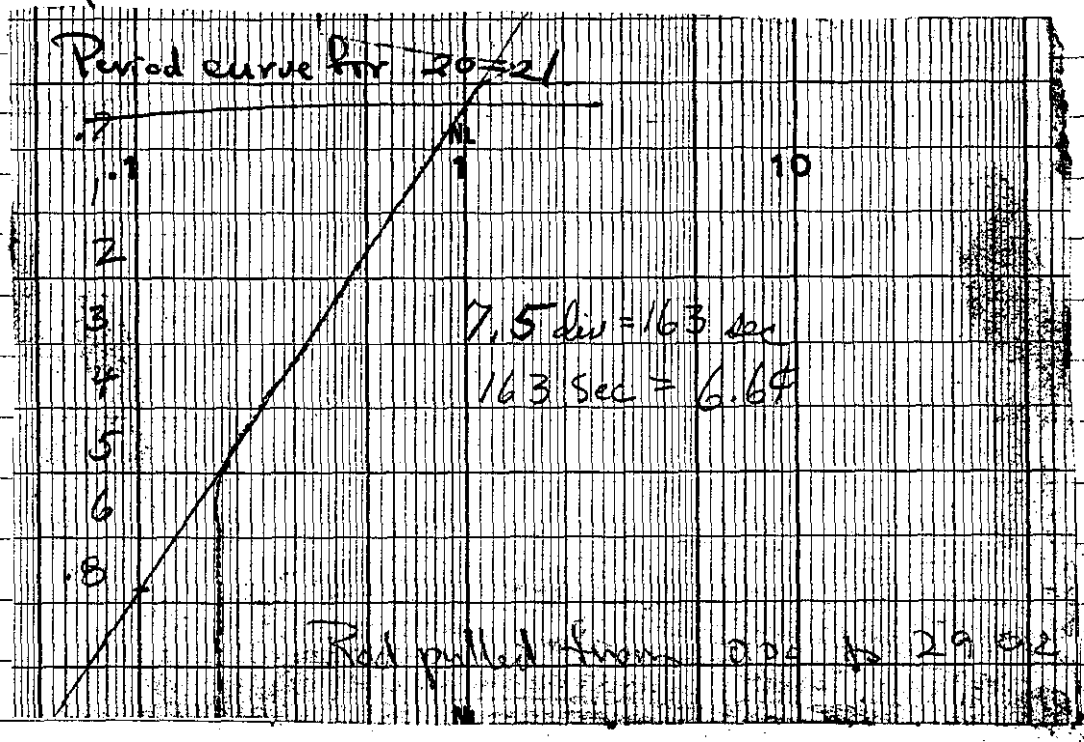
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Checked by MB
Instrument and Safeties Checked and Reset by RJ
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 3:00 (AM) (PM) Date 1-12 1956

Loading - same as 20-19 except slot 12, at boxes 16 & 30 now contain S.S. (There are now a total of 14 S.S. in slot 12)

Critical conditions

DC-3 50 (10x20) Tod 29.02
Log_N 0.14 Blade 19.13
R-1 3.9 (100x1000) Water height 109.3 cm.
Temp. 74.5



Expr. 20-21 Time 2:30 AM PM Date 1-12 1956
Purpose Homogenious box in position 37.

Personnel:

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB AM
Start Up OK'd by RJ Time 2:30 PM Date 1-12 1956

Loading - same as 20-20 except homogenious element now in ~~box~~ position 37.

Reactor was a little super critical with blade & rod all the way in. + water up.
Rod pulled out + positive period measured.
From previous runs today & from the e.c.c. control blade calibration curve, the value of the blade with 3 boron in core = ~~1.076~~ 1.06 × e.c.c. blade.
∴ the value of the blade from 19.13 → 0 = ~~25.6~~ 25.2 ¢
the excess reactivity of the reactor = 6.6 ¢

Total change in reactivity due to homogenious element in position 37. } ~~32.2~~ ¢ 31.8¢.

LogN 0.175
DC-3 75 (10×20)
Temp. 74.5°F
Height 109.5

Expr. 20-22 Time 3:29 AM ~~PM~~ Date 1-12 1956
Purpose Zero point with boron removed from box #3
Personnel:

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by RJ
~~Instrument and Safeties Checked and Reset by~~ RJ
"Source In" Checked by RJ Source No.
~~Emergency Equipment~~ Control Room ~~Operated~~ by MB
Red Light On by MB
Start-Up OK'd by RJ Time 3:20 AM ~~PM~~ Date 1-12 1956

Loading - exactly the same as 20-2 (page 22) except boron removed from box #3 instead of box 23.

Water up, blade & rod out - sub-critical.

Note:

Within the accuracy of ± 5 %, the control blade data we have taken today gives exactly the same shape curve as the c.c.c. control blade curve. Thus from the c.c.c curve, the value of any position of the blade with 3 boron can be obtained by multiplying the c.c.c curve value by ~~1.076~~ 1.06

Expr. 20-25 Time 3:45 AM PM Date 1-12 1956
Purpose Zero point with boraron removed from box 43.
Personnel:

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by MB
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start ~~Withdrawal~~ by RJ Time 3:56 AM Date 1-12 1956

.upt Loading - same at 20-22 except fuel added to slot 12 in boxes ~~8 & 10~~ 8 & 10. 4-20# in box 8
15-17 - " 10.

Still sub-critical by about 160 sec. negative period

Note.
Evaluation of center homogenious box yields ~~51.4¢~~
including: evaluation of fuel removed:

box 17 slot 12, 11.4¢
box 31 slot 12, 10.3¢ } x2

blade correction: 14.65 → 16.01 0.7¢
zero shift correction. 3.1¢
50.2¢.

50

Expr. 20-24 Time 4:10 PM Date 1-12 1956
Purpose Zero point with boron removed from box #3.

Personnel:

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by JL
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 4:10 (AM) PM Date 1-12 1956

Loading - same as 20-23 except fuel added in slot 12 box 24. (fuel plate #3-41 added)

Critical conditions:

Log N	0.15	Blade	20.49
DC-3	50 (10×20)	Rod	29.02
R-1	3.7 (100×1000)	Water	109.4
		Temp.	74.5°F

Expr. 20-25 Time 4:25 AM (PM) Date 1-12 1956
Purpose Homogenious box in position #. 43

Personnel:

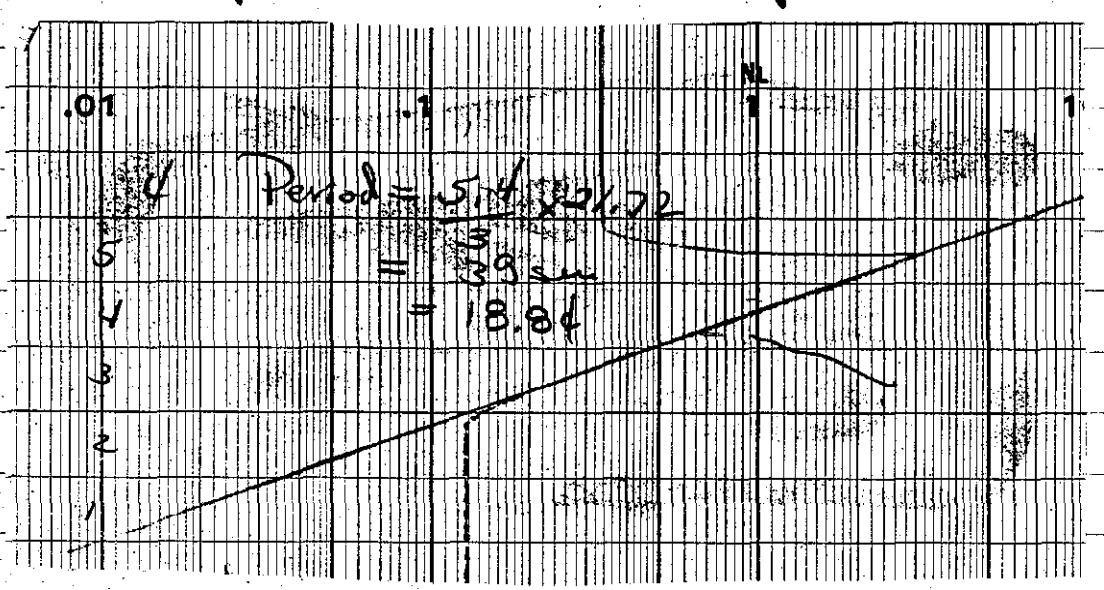
START-UP CHECK LIST
Equipment Checked by JL Personnel Check by RJ
Instrument and Safeties Checked and Reset by JL
Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MJB
Red Light On by MJB
Start-Up OK'd by RJ Time 4:25 AM (PM) Date 1-12 1956

Loading - same as 20-24 except homogenious element in position 43.

Critical condition

Log N	0.14	Blade ~~109.4~~	7.93
DC-3	50 (10x20)	Rod	29.02.
R-1	3.6 (100x1000)	Water	109.2
Temp.	74.5 °F		

Blade pulled to 20.51 + positive period measured measured



52

9 L
4-27

Expr. 27-1 Time 9:35 AM PM Date 1-13 1956

Purpose Evaluation of half plate in box 25 with 3 boron

Personnel:

INSTRUMENT CHECK

Date 195 Time AM PM Source No.

Instrument	Trip Value	Scale	Source Strength	Pen-Up Scale
DC-1				
DC-2				
DC-3	✓	75	10x20 3" 1/2 Sr	
Log N	✓			
R-1	✓	6.3	1000x100	
R-2				
P. M.	✓		806 ✓ 2"	

Log N calibration 0.068

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by JL

Instrument and Safeties Checked and Reset by JL+MB

"Source In" Checked by JL Source No.

Emergency Equipment in Control Room Checked by MB

Red Light On by JL

Start-Up OK'd by JL Time 9:45 AM PM Date 1-13 1956

Loading — Same as 20-24 except full plate #4-27 added to slot 12 box 22 and half plate #961 put in place of full plate 12-25 in slot 7, box 25.

Went up on power with blade at 23.60 + source out to get another calibration point — to low & power-line not straight

Critical conditions —

Blade	12.37	DC-3	47 (10x50)
Rod	29.02	Log N	0.28
Water	110 cm.	R-1	3.9 (200x1000)
		Temp.	74.5° F

Expr. 21-2 Time 10:30 (AM) PM Date 1-13 1956
Purpose Evaluation of half plate in box 25. with 3 boron.
Personnel:

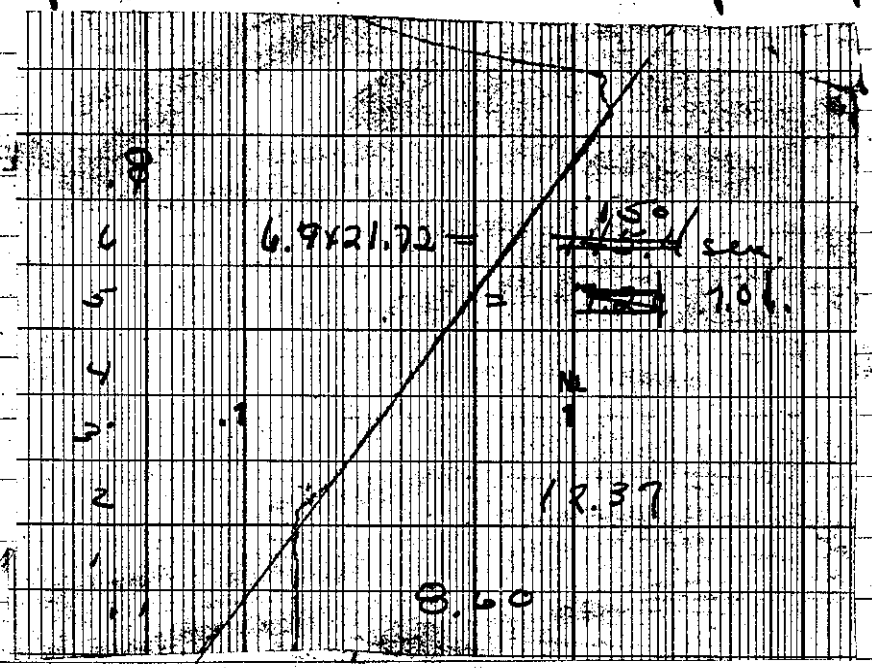
START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by JL Time 10:30 (AM) PM Date 1-13 1956

Loading - same as 21-1 except full plate 12-25 re-inserted into slot 7, box 25 in place of the half plate.

Critical conditions -

DC-3	61 (20x10)	Blade	8.605
R-1	4.15 (100x1000)	Rod	29.02
$\log N$	0.16	Water height	109.4
Temp.	74°		

Blade pulled from 8.605 to 12.37 & positive period measured.



Expr: 21-3 Time 11:05 AM PM Date 1-13 1956

Purpose Evaluation of half plate in box 25 with 3 boron.

Personnel:

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by MB

Instrument and Safeties Checked and Reset by JL

"Source In" Checked by JL Source No.

Emergency Equipment in Control Room Checked by MB

Red Light On by MB

Start-Up OK'd by JL Time 11:05 A Date 1-13 1956

Loading → same as ~~20-1~~ 21-1 except s.s. plate in slot 7, box 25 instead half plate.

Critical Conditions -

Log N	0.16	Blade	13.765
DC →	66 (20×10)	Rod	29.018
R-1	2.7 (100×1000)	Water	109.2
Temp.	74° F.		

Expr. 20-26 Time 1230 PM Date JAN 13 1956
Purpose
HOMOGENEOUS IN BOX 43
Personnel: MB DWM

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safety Checked and Set by DWM
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by DWM
Red Light On by DWM
Start-Up O.K'd by MB Time 1230 PM Date JAN 13 1956

N.B. ZERO RUN FOR THIS IS EXPR 21-3.

LOADING: SAME AS 21-3, with BOX ~~23~~ 43 EXCHANGED FOR HOMOGENEOUS ELEMENT (SEE P. 56 FOR U-235 content of HOMO ELEMENT.

CRIT. COND.

Water Ht	109.5	R-1	4.8 X 100 X 1000
Water Temp	74	Log N	.17
Control Blade	13.93	DC-3	63 X 10 X 20
" Rod	29.02		

FUEL DILUTION IN HOMO. ELEMENT

HOMO. ELEMENT WEIGHING	8025	
Removed 311 cc fuel	7636	> 389 g
Added 380cc H_2O	8008	> 372 g

Plastic Flask	2783	
Added 311cc fuel	3172	> 389 g

Graduate	443.43 g
+311cc fuel	829.89 g
	386.46 g

Graduate + 423 cc H_2O	869.55
+ 43 cc H_2O	487.64
380cc	376.91

× .997 g/cc = 379 g

386.46 g × 0.1625 g U-235/g Soln = 62.80 g U-235 Removed

450.54
62.80
387.74 g U-235 HOMO Q = 451 g plates.

Expr. 20-27 Time 1:20 (AM) (PM) Date 1-13 1956
Purpose Zero run - boron out of box 23

Personnel:

START-UP CHECK LIST

Equipment Checked by DM Personnel Check by DM
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by DM Source No. M13
Emergency Equipment in Control Room Checked by M13
Red Light On by M13
Start-Up OK'd by DM Time 1:20 (AM) (PM) Date 1-13 1956

Loading — exactly the same as 20-8, page 29.:
(a) complete loading of 14 1/2 plates per box minus:
2 d full plates (replaced by s.s.) and 4 half plates.
(b.) complete boron loading of 3 full plates per box minus
3 full plates from box 23 (replaced by s.s.)

Reactor not critical. ~ -200 sec period

(This loading went critical on Jan 11 at 16.01 on the blade.)

Reynolds

58

Expr. 20-28 Time 1:59 (AM) PM Date 1-13 1956
Purpose Zero run - boron out of box 23.

Personnel:

START-UP CHECK

Equipment Checked by DM DM
Instrument and Safety [illegible] DM
"Source In" checked by DM
Emergency Equipment in Control Room checked by MB
Red Light On by: MB
Start-Up OK'd by DM Time 1:40 (AM) PM Date 1-15 1956

Loading - same as 20-27 ~~plate~~ except the two Rulf plates in boxes 9 & 37 exchanged by fuel plates 15-9 & 510 respectively.

Still sub-critical.

Expr. 20-29 Time 2:25 AM PM Date 1-13 1956
Purpose Zero run - boron out of box 23.

Personnel:

START-UP CHECK LIST

Equipment Checked by DM Personnel Check by DM
Instrument and Safety Circuits Checked and Tested by DM
Source In DM
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DM Time 2:25 AM PM Date 1-13 1956

Loading - same as 20-27 except all half plates have been exchanged by full plates and full plates added to boxes 3, 20, 26, & 4/3.

Box	3	9	20	21	25	26	87	4/3
now contains in slot 12.	6-32	15-9	1-16	505	506	3-41	510	~~15-14~~

∴ we now have a full loading of 14½ plates per box minus 20 plates (replaced by S.S.)

Critical conditions

DC-3	80(10x20)	Blade	10.~~50~~ 46
LgN	0.19	Rod	29.02
R-1	5.5(100x100)	Water	109.6 in.
		Temp.	74°

Expr. 20-30 Time 2:45 (AM) Date 1-13 1956
Purpose Depleted homogenious element in position 23.
Personnel:

START UP CH[illegible]
Equipment Checked by DM [illegible] MB
Instrument and Safeties Checked and [illegible] DM
Source In[illegible] Checked by DM
Emergency Equipment in Control Room [illegible] by MB
Red Light On by MB
Start Up OK'd by DM Time 2:45 (AM) Date 1-13 1956

Loading -
Same as 20-29 except homogenious element in position 23.

Reactor too reactive -
Critical at water height of 96 cm. with blade + water in.

Expr. 20-31 Time 5:00 AM (PM) Date 1-15 1956
Purpose Depleted homogenious element in box 23
Personnel:

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by DM & DE
Instrument and Safety Circuits Checked and Reset by DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Lights Out by MB A.M.
Start-Up O.K'd by DM Time 3:00 (PM) Date 1-13 1956

Loading –
same as 20-30 except plate 15-17 pulled & replaced by S.S.

From exp. 20-14 plate 15-17 is worth 11.4 ¢

Critical conditions

Water	109.5	DC - 3	64/110×20
Blade	5.70	R - 1	4.4 (1000×100)
Rod	29.02	Temp.	73.5-74
		Log N	.15

Blade worth from 5.70 → 10.46 = 7.4 ¢
Plate worth 11.4 ¢
Value of depleted homogenious element 18.8 ¢
in box 23.

Expr. 22-1 Time 6:15 AM PM Date 1-16 1956

Purpose Zero Run — 2 boron plates per box

Personnel:

INSTRUMENT CHECK

Date 1-16 1956 Time 6:15 AM PM Source No.

Trip

Instrument	Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	73	10x20	
Log N	✓		12 sec.	
R-1	✓	4	1000x100	
R-2				
P. M.	✓		1"	

Log N calibration 0.065

Equipment Checked by MB checked by RJ DM

Instrument [illegible] DM

"Source In" [illegible] MB

Emergency

Red Light [illegible] RJ

Start-Up Ch[illegible] DM 7:45 Date 1-16 1956.

Loading —

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	1	13	B	B	4	6	6	14	9	7	9	12	11	B	15	8	2	10
material	f	f	f	B	f	s	f	f	s	f	f	s	f	B	s	f	f	f

except in slot 2, the following half plates are in the corresponding boxes: 5-7, box 7
5-11, box 11
5-35, box 35
5-39, box 39.

Also, 1-9* has replaced 1-23 and 1-23 is in ~~slot 9~~ slot 9, box 23 instead of S.S.

Reactor too reactive:
water at 82.2, $\log N = 0.1$; slightly super.
temp. ~~75~~ 750

APPR Fuel Element Data

	per plate	for 18 plates
Boron	0.2098 gm.	3.776 gm.
Uranium-boron loaded	23.962 gm.	431.3 gm.
Uranium-light loaded	12.448 gm.	224.06 gm.

16 17 18
8 9 10
f f f

steel

64

Expr. 22-2 Time 8:15 AM PM Date 1-16 1956
Purpose Zero Run - two boron plates per box.
Personnel:

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by RJ
Instrument and Safeties Checked and Reset by DM
Source In" Checked by DM Power ~0.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DM Time 8:15 AM PM Date 1-16 1956

Loading - same as 22-1 except slot 2 in the following boxes contains series five fuel (half plates) 9, 21, 25, & 37.

Still bo reactive - water height 96.25 (96.25): (blade & rod in, source out)

Expr. 22-3 Time 8:50 PM Date Jan 16 1966
Purpose Zero Run

Personnel: DWM MB WRJ

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by DWM
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by ✓
Red Light On by ✓
Start-Up OK'd by MB Time 8:55 PM Date Jan 16 1966

Loading: Same as 1 except for slot 2

The following boxes contain series 5 (half-plates)

3, 6, 8, 10, 12, 20, 22, 24, 26,
34, 36, 38, 40, and 43 (14 half-plates)

Total Loading 11 X 45 full plates
Element 23 1 Extra

Slot 2 { 14 X half plates
31 full plates

53 X 31.13 = 16, ~~592~~ 623.4 g

CRITICAL CONDITIONS: ELEMENT 23 has 13 Full plates

Water height	109.6 cm Hg	Log N	= ~~0.2~~ .17
Temp	74.5°F	DC-3	72 x 10 x 20
Control Blade	10.90	R-1	7.8 x 100 x 1000
Rod	29.02		

Expr. 22-4 Time 9:30 PM Date Jan 16 1956
Purpose Zero Run for APPR-1 23
Metallurgical plates 13-28
Personnel: DVM MB WRJ

START-UP CHECK LIST

Equipment Checked by MB Safety Rod Check by MB
Instrument and Safeties Checked by WRJ
"Source In" Checked by MB Fuse No.
Emergency Equipment in Control Room Checked by —
Red Light On by —
Start-Up OK'd by MB Time 9:30 PM Date Jan 16 1956

Loading: Same as 22-1 except slot 2.

Element 23 has extra plate

The following boxes have Series 5 (half-plates)

3, 6, 8, 10, 12, 18, 20, 22, 24, 26, 28, 34, 36, 38, 40, & 43

(16 half-plates) $11 \times 45 = 485$

Slot 2 { Full 23 1 29 1 29
half 16 8

533 = 16,592.3 g

CRITICAL CONDITIONS:

Water Height	109.4	Log N	0.16
" Temp	75.5	DC-3	70 x10 x20
Control Rod	29.02	R-1	4.7 x1000 x100
Blade	16.90		

Clean Crit.

From Blade calibration curve half plates ~~substituted~~ for full plates in slot 2 boxes 18 and 28 is worth

21.35 − 11.35 = 10.0 ¢

Est blade calib. @ 2 Boron = CC x 1.03

hence plate worth 10.3 ¢

ass
to ta

Expr. 22-5 Time 10^00 AM (PM) Date Jan 16 1956
Purpose APPR element in position 23

Personnel: [redacted]

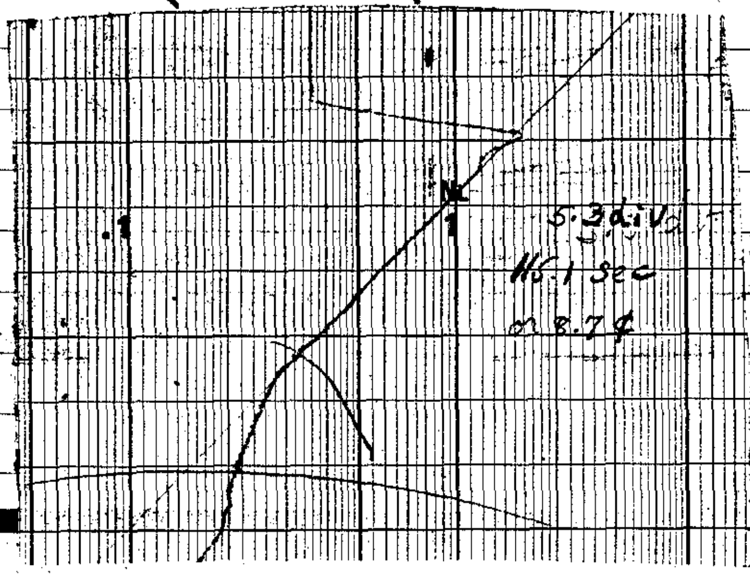
START-UP [redacted] LIST
Equipment Checked by DM [redacted] Check by RJ
Instrument and S... [redacted] RJ
Source ... Checked by RJ ... Source No.
Emergency Equipment ... Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 10^00 AM (PM) Date Jan 16 1956

Loading – same as 22-4 except APPR element now in position 23 instead of regular assembly element. For loading of APPR element see page 63.

Reactor super critical.
With source & rod out, and blade at 5.96, positive period was measured.
We will assume we know the value of the blade between 16.90 & 5.96 inches, from the c.c.c. calibration.
We will add to this the value of the period just taken to obtain the total change in reactivity due to the APPR element.

c.c.c. value, 16.9 → 5.96 = 17.4¢
assumed value for ↓ boron loading: 17.9¢
total Δρ = 17.9 + 8.7
= 26.6 ¢.

MB



Expr. 22-6 Time 1055 = Jan 16 1956
Purpose
Zero Run (~~ABBR is Box 37~~)
Personnel: WRJ, MB DWM

START-UP CHECK LIST
Equipment Checked by MB Personnel Briefed by WRJ
Instrument and Scram's Checked by DWM
"Source In" Checked by WRJ Scram Ckd. —
Emergency Equipment in Control Room Checked by — DWM
Red Light On by —
Start-Up OK'd by WRJ Time 1055 ~~AM~~ PM Date Jan 16 1956

Loading: 12-34 Fuel in Box 37 Slot 12
Half plates in Slot 2 in Boxes, 3, 6, 8, 10, 12, 20, 22,
(14 half-plates) 24, 26, ~~28, 30~~, 34, 36, 38, 40, 43
Full plates in rest of slot 2
Rest same as 22-1
Total loading same as 22-3.

CRITICAL CONDITIONS:

Water Height	109.	log N	0.08
" Temp		DC-3	
Control Rod	29.02	R-1	
" Plate	Out		

SUB CRITICAL ~ -400sec

Expr. 22-7 Time 11 15 PM Date Jan 16 1956
Purpose
Zero Run (~~Rod~~ in Box 32)
Personnel: WRJ, MB · DWM

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Interlocks Checked and Reset by MB
"Source In" Checked by WRJ Source No. —
Emergency Equipment in Control Room Checked by DWM
Red Light On by —
Start-Up OK'd by WRJ Time 11 15 PM Date Jan 16 1956

LOADING: Same as 22-6 except

Boxes 3 & 43 Slot 2 . half plate removed

series 13 Full plate in center.

Slot 2 Half plate in 6, 8, 10, 12 20, 22, 24, 26, 34, 36, 38 & 40

series 13 in remaining boxes.

CRITICAL COND.

Water Height	109.4	log N	0.13
Temp	75.5	DC-3	50 x 10 x 20
Rod	29.02	R-1	3.4 x 100 x 100
Blade	16.65		

Expr. 22-8 Time 1140 AM Date 16 Jan 1956
Purpose APPR Type Element (Heavy Loaded) in Box 37
Personnel: WRS, MB, DM

START-UP CHECK LIST
Equipment Checked by MB Assembly by RS
Instrument and [illegible] DM
"Source [illegible] DM
Emergency [illegible] RS
Red Light [illegible] RS
Start Up Ordered by DM Time 1140 CST Date 16 Jan 1956

Loading: Same as 22-7, except that the APPR Type Element is now in Box 37.

Critical Conditions:

Log N	.13	Control Blade	8.06
DC-3	55 X10X20	Control Rod	29.02
R-1	3.5 X100 X1000	Water Height	109.3
Water Temp	76.5		

The interchange of the APPR type element for Fuel Box 37 was worth from 16.65 to 8.06 on the Blade, or 14.25¢ using the Calibration Curve.
∴ Value = 14.25 × 1.03 = 14.7¢. MB

Expr. 229 Time 4 50 AM Date 17 Jan 1956
Purpose APPR Type Element (Heavy Loaded) in Box 43
Personnel: MB RJ, DM

INSTRUMENT CHECK

Date ____ 195__ Time ____ AM Source No. ____

Instrument	Trip	Start-Up Scale
DC-1		
DC-2		
DC-3	70	10 X 20 4n
Log N		12 Sec.
R-1	6	.9 x 1000 Contact
R-2		x100
P. M.		1 1/2 n

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by DM
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by MB Source No. ____
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ
Start-Up OK'd by MB Time 450 AM Date 17 Jan 1956

Loading: Same as 22-8, except that the APPR Type element is in Box 43, the normal (12F, 28, 4 SS) Box was returned To Position 37.
Full Plates 13-20, and 13-26 were put in slot 12 of Boxes 20 & 26 in place of ½ plates 5-20, & 5-26.

Critical Conditions

Log N .08
DC-2
R-1
Water Tem.

Control Blade ~20
Control Rod 29.02
Water Ht 109.5

Expr. 22-10 Time 5-20 AM Date 17 Jan 1956
Purpose APPR Type Element in Box 43

Personnel: MB, URS, DM

STARTUP CHECK LIST

Equipment Checked by DM Date DM
Instrument and Safety Check by MB
"Source In" Checked by MB
Emergency Equipment RS
Red Light On by RS
Start-Up OK'd by MB Time 5-20 Date 17 Jan 1956

Loading: Same as 22-9, except that fuel plates 13-22, 13-24 were put into Boxes 22-24, Slot 12, in place of 2 fuel Plates 5-22 + 5-24.

This change in loading was made in order to bring the Control Blade to a lower position.

Critical Conditions:

Log N	.17	Control Blade	6.27
DC-3	75 X10X20	Control Rod	2902
R-1	4.6 100 X1000	Water Ht.	109.6
Water Temp	76.5		

Expr. 22-10 Time 5-45 AM Date 17-Jan 1956
Purpose APPR - ~~Fet~~ Type Element evaluation
Personnel: MB WRS DM

START UP CHECK LIST
Equipment Checked by MB Personnel Check by RS
Instrument and Safeties checked by MB
Source Inst. checked by MB Source No.
Emergency Equipment, Control Room Checked by RS
Red Light On by RS AM
Start-Up OK'd by MB Time 5-45 Date 17 Jan 1956

Loading: same as 22-10, with Normal Box 43 (with a fuel plate 12-34) in s/ot 12, replacing the APPR Type Box.

Critical Conditions:

Log N .18	Control Blade 12.44
OC-3 #25 x 10 x 20	Control Rod 29.02
R-1 47 x 100 x 1000	Water Ht. 109.6
Water Temp 77°F	

The APPR Type Element is worth from 6.77 to 12.44 on the Control Blade, or ~~9.0~~ 9.1
∴ Corrected worth = 9.0 x 1.03 = 9.4 ¢. — MC

74

Expr. 23-1 Time 8:40 AM (PM) Date 1-17 1956
Purpose C.C.C. critical mass.

Personnel:

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by RJ
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DM Time 8:40 AM (PM) Date 1-17 1956

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	13	2	14	4	5	9	7	5	9	7	11	12	11	14	15	8	1	10
	f	s	f	s	s	f	s	½f	s	f	s	s	f	s	s	f	s	f
		s		s	s		s		s		s	s		s	s		s	

Reactor very sub-critical with blade + rod out.
Source out, water up. Temp. 75.5

Expr. 23-2 Time 9:05 AM (PM) Date 1-17 1956
Purpose S.C.C. - critical mass.

Personnel:

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by RJ
Instrument and Safeties Checked and Reset by RJ
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DM Time 9:05 AM (PM) Date 1-17 1956.

Loading - pure 7½ (same as 23-1) except full plates now in slot 8 in the following boxes.

15-1 in box 14
15-2 in box 18
15-3 in box 28
15-4 in box 32.

Critical conditions -

DC-3	76 (10x10)	Blade	13.05
Log N	0.084	Rod	29.02
R-1	2.3 (100x1000)	Water	109.7.
Temp	75.5°		

C.M = 7.5 x 1.400 = 10,500
4 x 155 62
10,562 gms
Blade Correction ~ 10% 20 gms
10,542 gms.

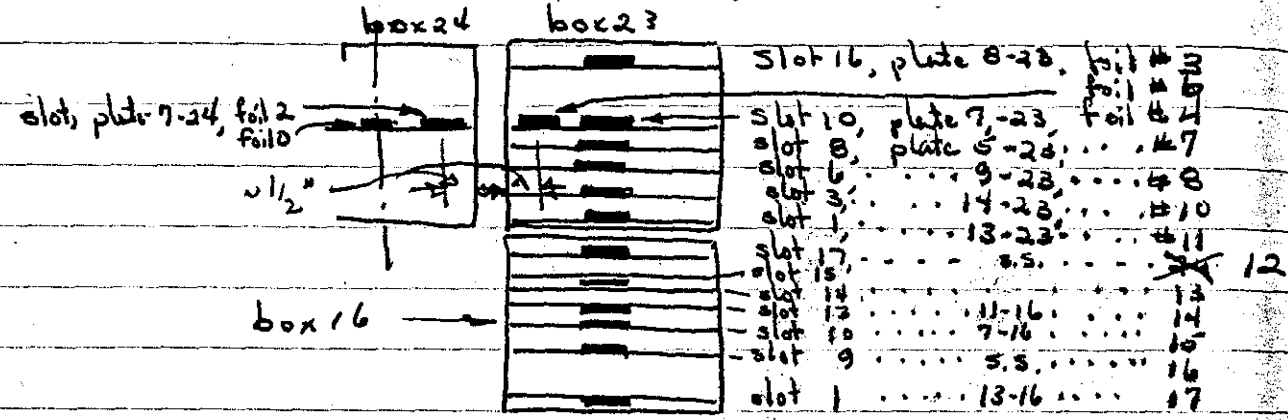
Expr. 23-3 Time 10:50 AM Date 1-17 1956
Purpose Fine structure flux with Dy in C.C.C.

Personnel:

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by MB
Instrument and Safeties Checked and ... MB
"Source In" Checked by RJ ... No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by MB
Start-Up OK'd by RJ Time 10:50 AM Date 1-17 1956

Loading - same as 23-2.
Foil location. - all foils bare dysprosium



1/e final power (0.56) at 11:08:46

Run conditions -

DC-3	—	Rod	29.02
R-1	5.5 (1000×1000)	Blade	13.80
DC-1	47 (50)	Height.	109.2
Temp.	75.5°		
Log N	1.50		

Expr. 24-1 Time 5:10 (AM) PM Date 1-18 1956
Purpose Zero Run – Install new cal. box for C.C. loading. – mass evaluation at box 25, slot 8
Personnel: DM, RJ, MB.

INSTRUMENT CHECK

Date 1-18 1956 Time _____ AM PM Source No. _____

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	←	To	10x20	2"
Log N	←		Run.	
R-1	←	6	3x1000 x100	e
R-2				
P. M.	—			1"

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by DM
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by DM Source No. _____
Emergency Equipment in Control Room Checked by MB
Red Light On by RJ
Start-Up OK'd by DM Time 5:15 (AM) PM Date 1-18 1956

12

Note: - again on Log N turned up so that recorder and meters read same value.

Loading - same as 23-2 except s.s. in slot 8, box 25 instead of Ruff fuel plate.

Critical conditions –

Log N	0.18	Blade	20.13
DC-3	14 (10x20)	Rod	29.02
R-1	3.7 (100x1000)	Height	109.5
Water Temp.	75.5°		

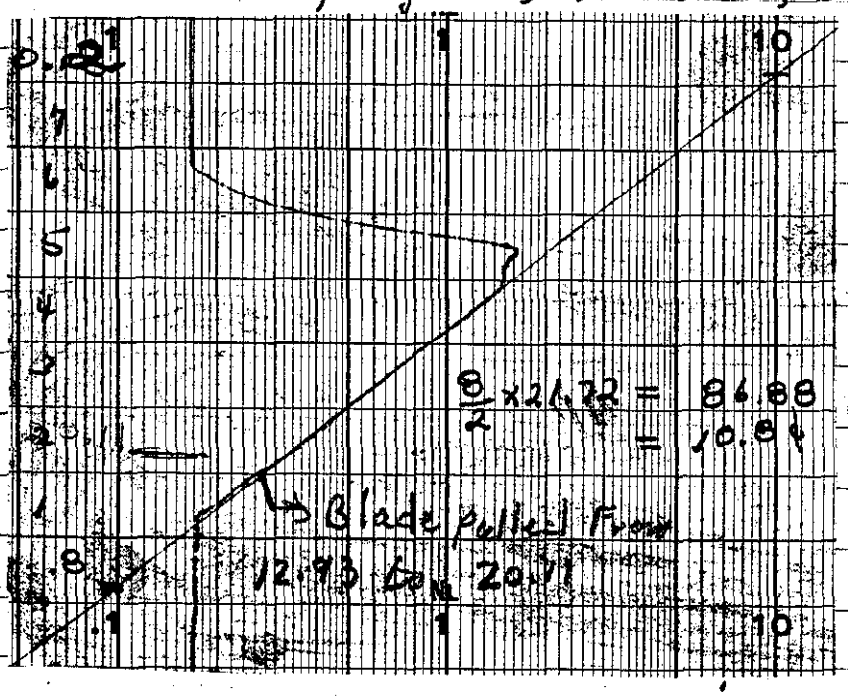
Expr. 24-2 Time 5:50 (AM) PM Date 1-18 1956
Purpose Zero Run. also evaluation of ½ Fuel plate in Slot 8 Box 25.
Personnel:

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by RJ
Instrument and Safeties Checked and Reset by: DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DM Time 5:50 (AM) PM Date 1-18 1956

Loading - Same as 23-2.
Critical conditions -

Log N	.18	Blade	12.93
DC-3	59 X 10 X 20	Rod	29.02
R-1	3.8 X 100 X 1000	Water.	109.6
Temp.	75.5°F		

Blade pulled out to 20.11 to get a period evaluation of the fuel (½) in slot 8, Box 25.



$\frac{8}{2} \times 21.22 = 86.88$
$= 10.8^{\phi}$

This period measurement shows the ½ plate in slot 8 Box 25 to be worth 10.8¢ when exchanged for a steel plate.

Expr. 24 - 3 Time 740 AM PM Date 18 Jan 1956
Purpose Evaluation of APPR Type Fuel Box (Light Loaded) in ~~Core~~ Position 23
Personnel: MB WRJ DM

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by RJ
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ AM
Start-Up OK'd by MB Time 740 Date 18 Jan 1956

Loading: Same as 24-2 except that the APPR Type Box is in Position 23 in place of the normal Fuel Box (with 7½ plates). The APPR Type element has 90% of the fuel which a normal ~~plate~~ Box contains in 7½ plates, distributed over 18 metalurgical fuel Plates.

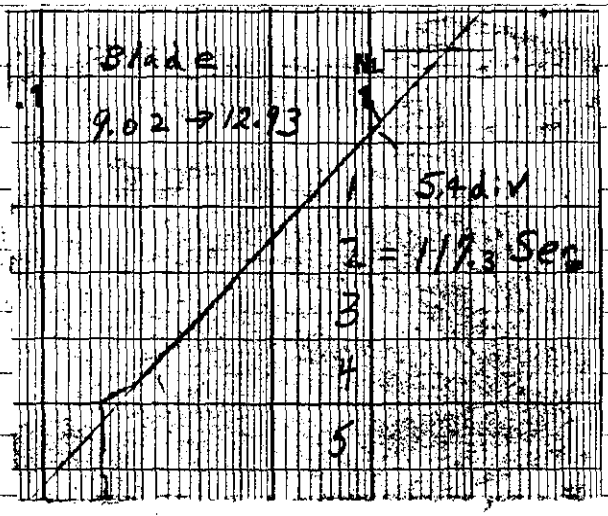
Critical Conditions.

Log N	.16	Control Blade	9.02
DC-3	64 x 10 x 20	Control Rod	29.02
R-1	36 x 100 x 1000	Water Ht.	109.6

Temp 75.

The APPR Type Element is worth from 9.02 to 12.93 on the Control Blade, or 8.6¢ by period measurement.

(See over for period measurment)



Period Measurements on P. 78 & 80 are with log N recorder agreeing with log N meter on panel.

There is some question as to the correct use of the blade calibration, because the calibration curve differs appreciably from these two measurements.

12.93 → 20.11 = 10.8 ¢ Calib Curve 9.6 ¢

9.02 → 12.93 = 8.6 ¢ " " 5.8 ¢

Expr. 24-4 Time 11 25 AM PM Date Jan 18 1956
Purpose
Zero Run (Clean Critical)
Personnel:

START-UP CHECK LIST
Equipment Checked by WRJ Personnel Check by WRJ
Instrument and Safeties Checked and Reset by WRJ
Source Installed by MB Source No —
Emergency Equipment in Control Room Checked by DNM
Red Light On by ✓
Start-Up OK'd by MB Time 11 25 AM PM Date Jan 18 1956

Loading : Same as 23-2

CRITICAL CONDITIONS :

Water Height	109.5	Log N	0.17s
" Temp	75.5	DC-3	65x10x20
Control Blade	16.19	R-1	37 x100x1000
" Rod	29.02		

5¢
3¢

Crit est @ 1140 PM 16.19 → 20.3 ¢
12.93 → 14.9
Reactor Δk drift = 5.4 ¢

Expr. 24-5 Time 1155 AM Date 18 Jan 1956
Purpose Evaluation of APPR Type Element (Light Loaded) in Box 37
Personnel: MB, RJ, DM

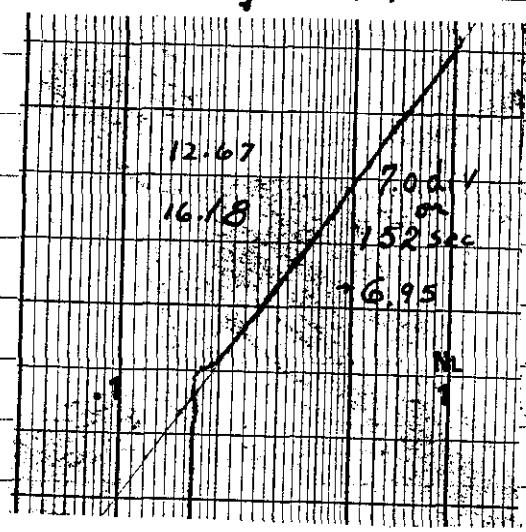
START UP CHECK LIST
Equipment Checked by RJ Check by RJ
Instrument and S... and ... MB
"Source In" ... MB
Emergency Equip... ... Locked by RJ
Red Light On by DM
Start-Up OK'd by MB Time 1155 AM Date 18 Jan 1956

24-4
Loading: Same as 22-4, with APPR Type Element in Box Position 37.

Critical Conditions: at 12.15 PM

Log N	.18	Control Blade	12.67
Dc 3	64 X 10 X 20	Control Rod	29.02
R-1	37 X 100 X 1000	Water Height	109.4
Water Temp	75.		

The Control Blade was moved From 12.67 to 16.19 and a period measurement taken to evaluate the substitution of the APPR type Element. It was worth a measured 6.95 ¢ in Box 37



Expr. 24-6 Time 12.45 AM Date 19 Jan 1956
Purpose Evaluation of APPR Type Element (Light Loaded) in Box 3-3
Personnel: MB, RS, DM, DUPW.

START-UP CHECK LIST
Equipment Checked by _____ Personnel Check by _____
Instrument and Safeties Checked and Reset by _____
"Source In" Checked by _____ Source No. _____
Emergency Equipment in Control Room Checked by _____
Red Light On by _____ AM
Start-Up OK'd by _____ Time _____ PM Date _____ 195__

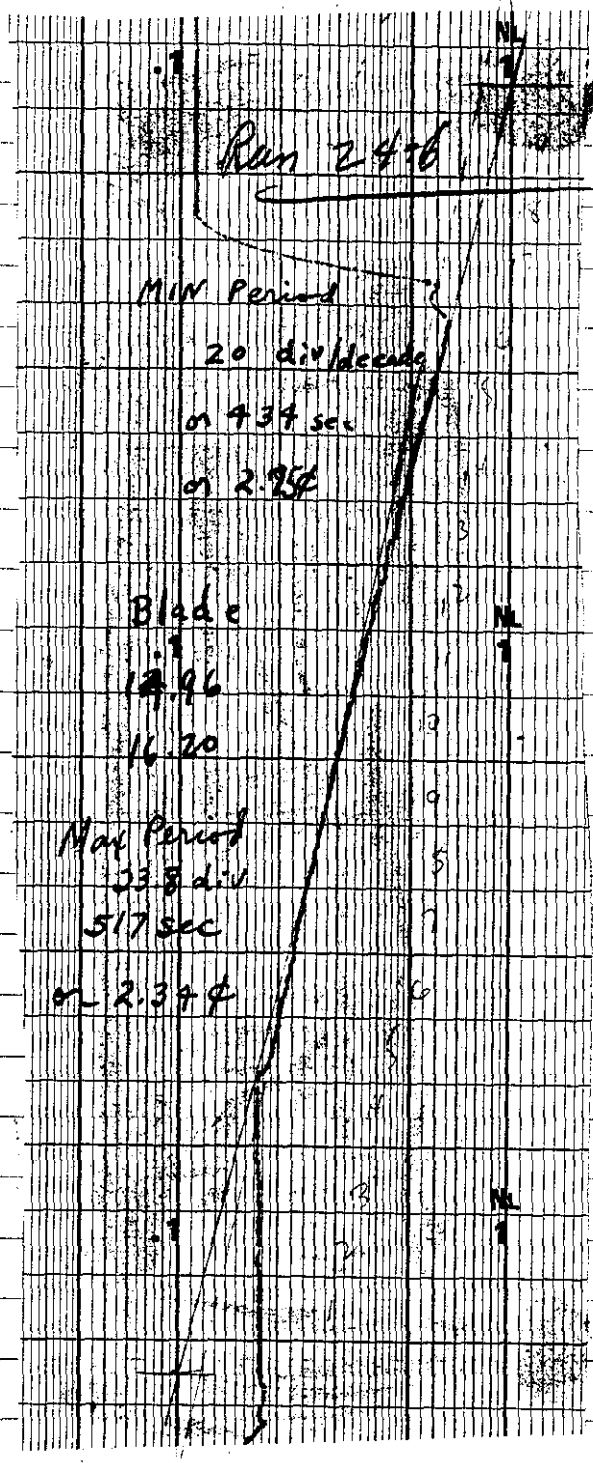
Loading: Same as ~~22-4~~ 24-4, with APPR Type Element in Box Position 43.

Critical Conditions at ~1 AM Jan 19

Log N	.18	Control Blade	14.96
DC-3	6.6x10x20	Control Rod	29.02
R-1	3.8x100x1000	Water Ht.	109.5

Water Temp 75.

Control Blade pulled to 16.~~13~~ 20 in order to get period measurement. The period was measured using a stop watch & DC-3


.1
Run 2-4-6
Min Period
20 div/decade
or 4.34 sec
or 2.3¢
Blade
.1
14.96
16.20
Max Period
23.8 div
5.17 sec
or 2.3¢
.1

Expr. 24-7 Time 1:25 AM ~~PM~~ Date Jan 19 1956
Purpose Zero Run
Personnel: DUPW, WRJ, MB, DWPc

START-UP CHECK LIST
Equipment Checked by DVPW Personnel Check by DVPW
Instrumentation [illegible] Checked and Reset by WRJ
"Source In" [illegible] MB Source No. —
Emergency [illegible] Control Room Checked by DWPc
Red Light On by —
Start-Up OK'd by WRJ Time 1:25 AM ~~PM~~ Date Ja 19 1956

Loading: Same as 23-2

CRITICAL CONDITIONS: @ 1:40 AM JAN 19

Water Height	109.3	R-1	37x100x1000
Temp	74.5°F	Log N	0.18
Control Rod	29.02	DC-3	65x10x20
Blade	16.13		

Expr. 23-4 Time 6:00 AM (PM) Date 1-19 1956
Purpose Zero run.

Personnel:

INSTRUMENT CHECK

Date 1-19 1956 Time 6:00 AM (PM) Source No. 10 mg source

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	70	10x20	6"
Log N	✓		36cm.	
R-1	✓	5	.9x1000x100	
R-2				
P. M.	—	0	800✓	2"

Loading - same as 23-2 p. 25 plus plates 15-7 + 15-8 in place of 5-20 + 5-26 respectively (in boxes 20 + 26, slot 8). Also the following plates have been used instead of the usual ones in order to free those for foil loading.

now in slot	box	instead of
6-1	1, 16	13-16
6-2	10, 16	7-16
6-3	13, 16	11-16
6-4	16, 16	8-16
6-5	18, 16	10-16
6-6	6, 23	9-23
6-7	10, 23	7-23
6-8	16, 23	8-23
6-9	10, 24	7-24

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by DM

Instrument and Safeties Checked and [illegible] DM

"Source In" Checked by DM

Emergency Equipment in Control Room Checked by MB

Red Light On by DM

Start-Up OK'd by DM Time 6:15 (PM) Date 1-19 1956

Critical Conditions –

Blade	14.51	R-1	4.7 (50x1000)
Rod	~~14~~ 29.02	DC-3	82 (10x10)
Water	109.5	LogN	~~Dot~~ 0.1
		Temp	75.5

8)

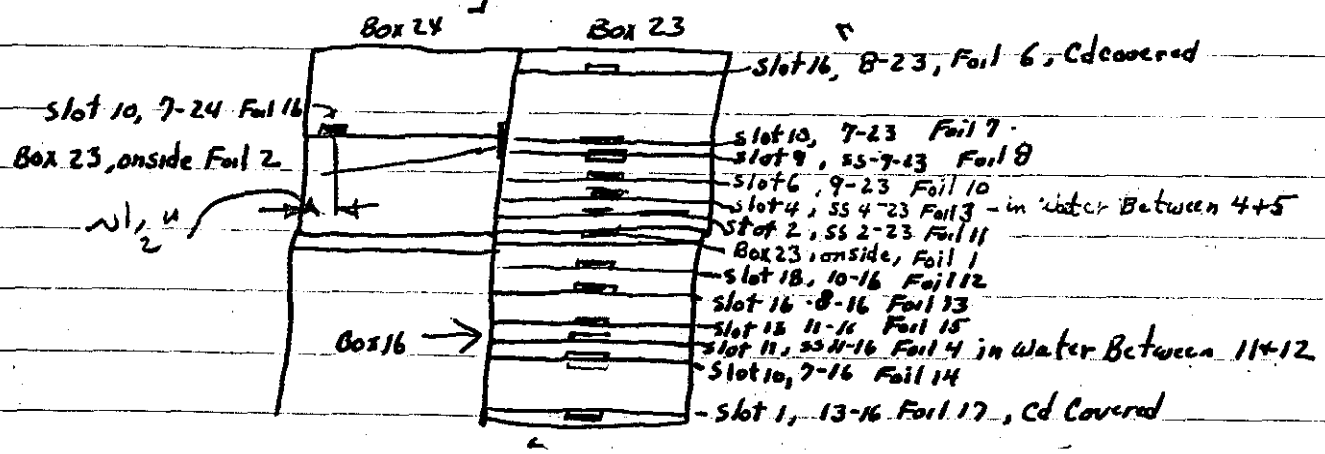
This is considered a "good enough" exercise run – for the foil exposure, half plates will be added to boxes 3 & 4.

Expr. 23-5 Time 8.35 AM (PM) Date 19 Jan 1956
Purpose Foil Run (Fine Structure) with Dg.
Personnel: MB - WRS

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by RJ
Instrument and Safeties Checked and [illegible] MB
Source In" Checked by MB [illegible]
Emergency Equipment in Control Room checked by RJ
Red Light On by RJ
Start-Up OK'd by MB Time 8.35 AM Date 19 Jan 1956

Loading: Same as 23-4, except that ½ plates 5-3, 5-43 in slot B, Boxes 3 & 43 were replaced by Full Plates 15-5 & 15-6 respectively.

Foil Loading



Position	Plate #	Foil Position	Foil #
23-16	8-23	0	6 w cd
23-10	7-23	0	7
23-9	SS-9-23	0	8
23-6	9-23	i	10
23-4	SS-4-23	water Between slots 4+5	3
23-2	SS 2-23	i	11
23-	on Box adjacent To Box 24		2
23-	" " " " " 16		1
16-18	10-16	i	12
16-16	8-16	i	13
16-13	11-16	i	15
16-11	SS-11-16	water Between slots 11+12	4
16-10	7-16	0	14
16-1	13-16	0	17 w. cd
24-10	7-24	i	16

Run Started at 8:53:42

Critical Conditions:

Log N	1.8	Control Blade	10.68
DC-3	— 6.0	Control Rod	29.02
R-1	~~7.85~~ X100X1000	Water Ht	109.6
Water Temp	75.5		

92

Expr. 24-8 Time 10:15 AM (PM) Date 1-19 1956
Purpose Evaluation of a.c.c. metallurgical box in position 23 — zero run.
Personnel: MB & RJ

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by RJ
Instrument and Safeties Checked and Reset by MB
Source In" Checked by RJ
Emergency Equipment in Control Room Checked by RJ
Red Light On by MB
Start Up OK'd by RJ Time 10:15 AM (PM) Date 1-19 1956

Loading —
Same as ~~23~~ (~~Hypothetical~~) 18 88 23-4 but all series six plates replaced by the "usual" plates.

Height.	109.5	Blade.	14.42.
R-1	38 (100×1000)	Rod	29.02
Log N	.165		
DL-3	71 (10×20)		
Temp.	75.5°f		

Expr. 24-9 Time 11:05 AM (PM) Date 1-19 1956.
Purpose Evaluation of C.E.C. metallurgical bar in position 23.
Personnel:

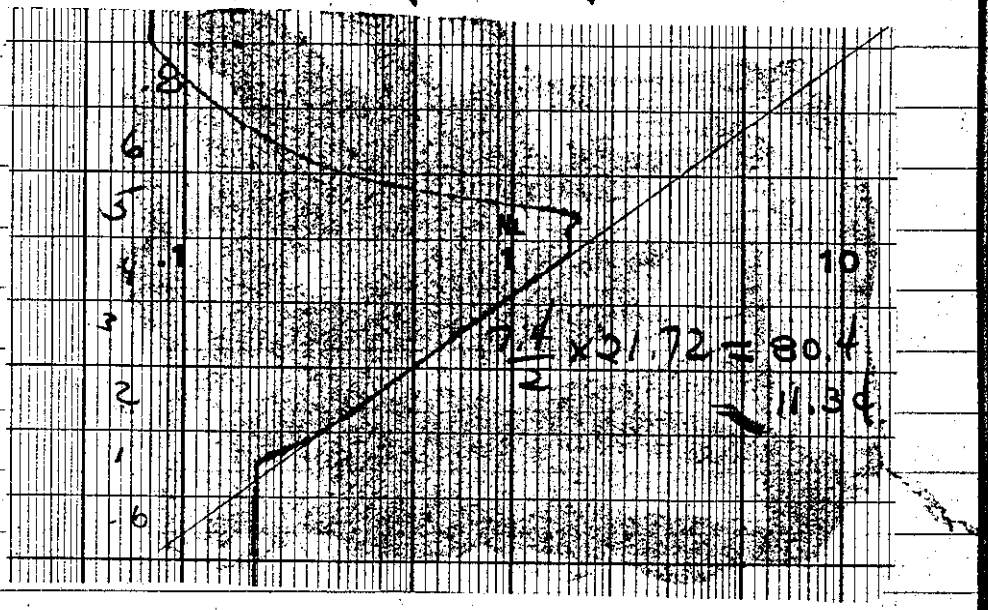
START-UP CHECK LIST
Equipment Checked by MB Personnel Check by RJ
~~Instrument and Safeties Checked and Reset by~~ RJ
"Source In" Checked by RJ Source No.
~~Emergency Equipment in Control Room Checked by~~ RJ
Red Light On by MB
Start-Up OK'd by RJ Time 11:05 AM (PM) Date 1-19 1956.

Loading - same as 24-8 except APPR element light loaded) in position 23.

Critical Conditions—

DC-3	38.5 (100×400	Blade	9.19
R-1	70 (10×20)	Rod	29.02.
$\log N$.	.165	Water.	109.2
Temp.	75.5°F		

Blade pulled to 12, d2 & positive period measured.



Expr. 25-1 Time 10:50 (AM) Date 1-23 1956

Purpose ~~Reactivity~~ Re-run or check of final evaluation curve.

Personnel: _____

INSTRUMENT CHECK

Date _____ 195__ Time _____ (AM / PM) Source No. _____

Instrument	Trip Wires	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	85	10×20 / 12 in.	2"
Log N	✓			
R-1	✓	5×5	.8×1000 ×100	
R-2				
P. M.	✓			1"
"				

Log N calibration - 0.018 - meter
0.081 - recorder pointer.

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by RJ

Instrument and Safeties Checked and Reset by MB

"Source In" Checked by RJ Source No. _____

Emergency Equipment in Control Room Checked by MB

Red Light On by MB

Start-Up OK'd by RJ Time 11:00 (AM / PM) Date 1-23 1956

Loading - same as 24-8 except slot 8 in the following boxes:

boxes:	Now contains
1	15-6
5	-5
21	-10
25	-11
41	-12
45	-13
3	SS
9	SS
16	SS
23	SS

Subcritical with Blade all the way out

Expr. 25-2 Time 12.30 AM (PM) Date 23 Jan 1956
Purpose Check of Fuel Evaluation Curve.
Zero Run
Personnel: MB, WRS

START-UP CHECK LIST
Equipment Checked by WRS Personnel Check by WRS
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start-Up OK'd by MB Time 1230 (CST) Date 23 Jan 1956

Loading

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series	13	2	14	4	5	9	7	5*	9	7	11	12	11	14	15	8	1	10
Type	F	SS	F	SS	SS	F	SS	F/2	SS	F	SS	SS	F	SS	SS	F	SS	F

*Slot 8 of the Following Boxes has the Series 5 ½ plate removed and the indicated Plate substituted for it.

Box 1	has in Slot 8	Fuel	15-6
5	" "	"	15-5
14	"	"	15-1
~~16~~			
18	"	"	15-2
20	"	"	15-7
21	"	"	15-10
25	"	"	15-11
26	"	"	16-8
28	"	"	15-3
32	"	"	15-4

Box 36	has in Slot 8	Fuel	15-14
38	"	"	15-16
41	"	"	15-12
45	"	"	15-13
3	"	" SS	8-3
7&9	"	" SS	8-9
16	"	" SS	8-16
23	"	" SS	8-23

Mass = 10.655 Kg 25

Critical Conditions

Log N: 0.20 Control Blade: 11.40

DC-3: 75 (10×20) Control Rod: 29.03

R-1: 4.5 (100×1000) Water Ht: 109.5

Water Temp: 74.5°F

The Blade position in this Run was too far in, so ½ plate will Be removed to bring the Blade Back out some.

Note: Top Grid Position

Just Before Run 25-1 the top Grid was positioned, and pencil lines drawn to aid in reproducing this position after all future removals of the top Grid.

Expr. 25-3 Time 12:41 AM Date 23 Jan 1956
Purpose Fuel Evaluation Curve
Zero Run
Personnel: MB RS

START-UP CHECK LIST
Equipment Checked by RS Personnel Check by RS
Instrument and Safeties Ch[illegible] by MB
"Source In" checked by MB [illegible]
Emergency Equipment in Cor[illegible] Checked by RS
Red Light On by RJ
Start-Up OK'd by MB Time 12:41 AM Date 23 Jan 1956

Loading: Same as ~~#~~ 25-2, except that Fuel plate 15-16 Box 38 slot 8, was replaced By ½ Fuel Plate 5-38

Critical Conditions

Log N	.2	Control Blade	15.59
OC-3	76 X 10X20	Control Rod	29.02
R-1	4.5 X100 X 1000	Water Ht.	109.5
Water Temp	75.5		

als

This gives an evaluation of Full to ½ half plate interchange in Slot 8, Box 38, of From 11.4 to 15.59 on the Control Blade.

Expr. 25-4 Time 12.55 AM Date 23 Jan 1956
Purpose Fuel Evaluation
Box 3 slot 8
Personnel: MB RS

START-UP CHECK LIST
Equipment Checked by RS Personnel Checked by RS
Instrument and Safeties Checked and [illegible] MB
"Source In" Checked by MB
Emergency Equipment in Control Room Checked by RS
Red Light On by RS AM
Start-Up OK'd by MB Time 1255 Date 23 Jan 1956

Loading. Same as 25-3, except that ½ Fuel Plate 5-3 was inserted in slot 8, Box 3, in place of SS 8-3.

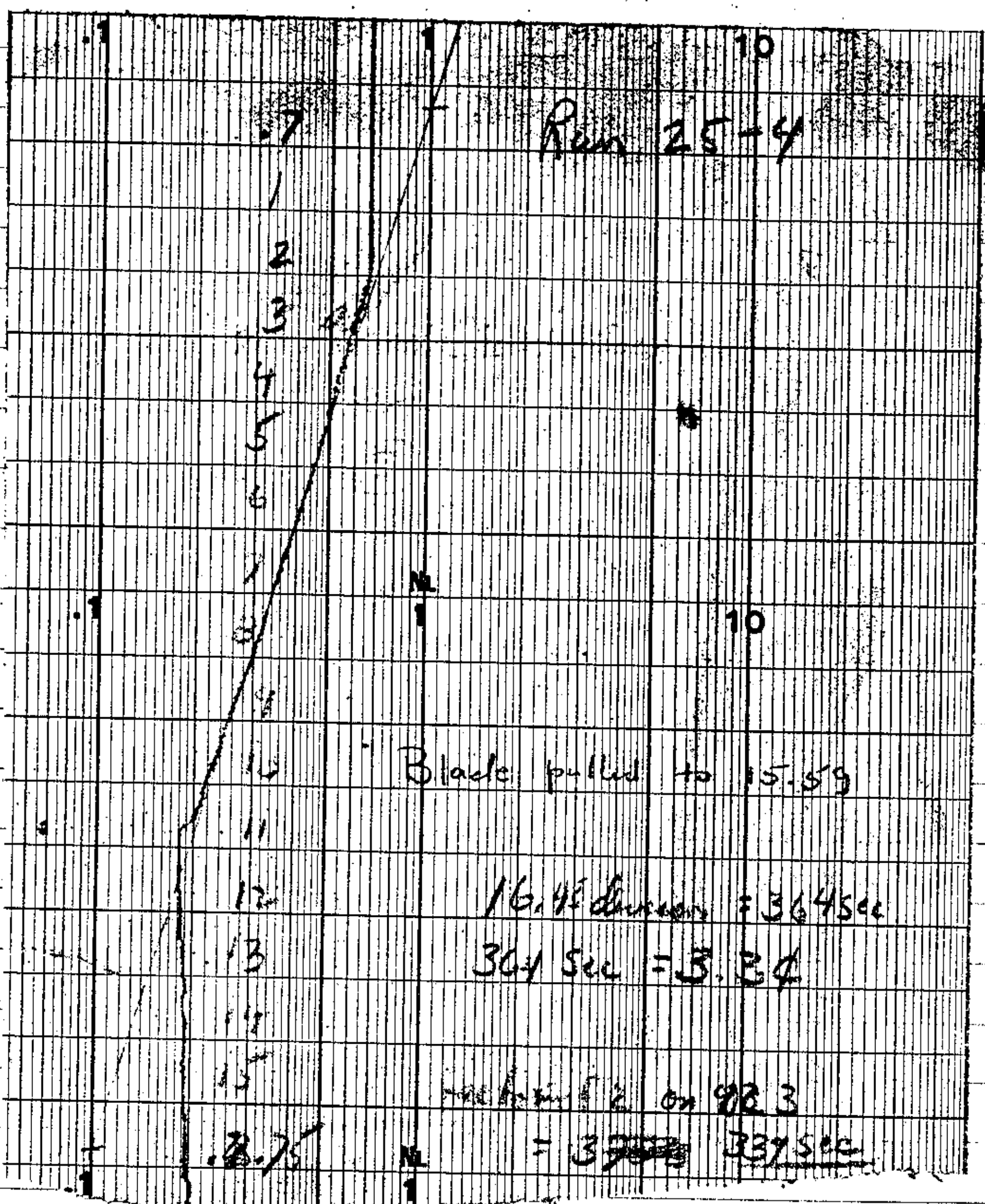
Critical Conditions:

Log N	.18	Control Blade	13.94
DC-3	7.4 x10x20	Control Rod	29.02
R:1	4.4 x100x1000	Water Ht.	109.2
Water Temp	75.5		

A ½ plate in Slot 8, Box 3 is worth from 15.59 to 13.94 on the Control Blade.

The Control Blade was pulled out to 15.59 in order to get a period measurement of fuel ½ plate worth.

While the reactor was on a t period, it took 339 seconds to increase in power by a factor of 2. (By DC-3.)


Run 25-4
Blade pulled to 15.5g
16.45 division = 364 sec
364 sec = 3.34
337 sec

Expr. 25-5 Time 1:20 AM (PM) Date 23 Jan 1956
Purpose Recheck Zero. Fuel Evaluation.

Personnel: MB WRS

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and [illegible] MB
~~"Source In" Checked by MB~~ [illegible]
Emergency Equipment in Control Room Checked by RS
~~Red Light On by RS~~ Added
Start-Up OK'd by MB Time 1:20 (PM) Date 23 Jan 1956

Loading: Same as 25-3.

Critical Conditions at 1.30 PM

Log N	.19	Control Blade	15.83
Oc-3	74 x 10 x 20	Control Rod	29.03
R-1	4.45 x 100 x 1000	Water Ht.	109.6
Water Temp	75.5		

Expr. 25-6 Time 1.35 AM Date 23 Jan 1956
Purpose Fuel Evaluation.
½ plate Box 9, Slot 8
Personnel: MB RS

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and [illegible] MB
Source In Checked by MB [illegible] Source No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start Up OK'd by MB Time 1:35 AM Date 23 Jan 1956

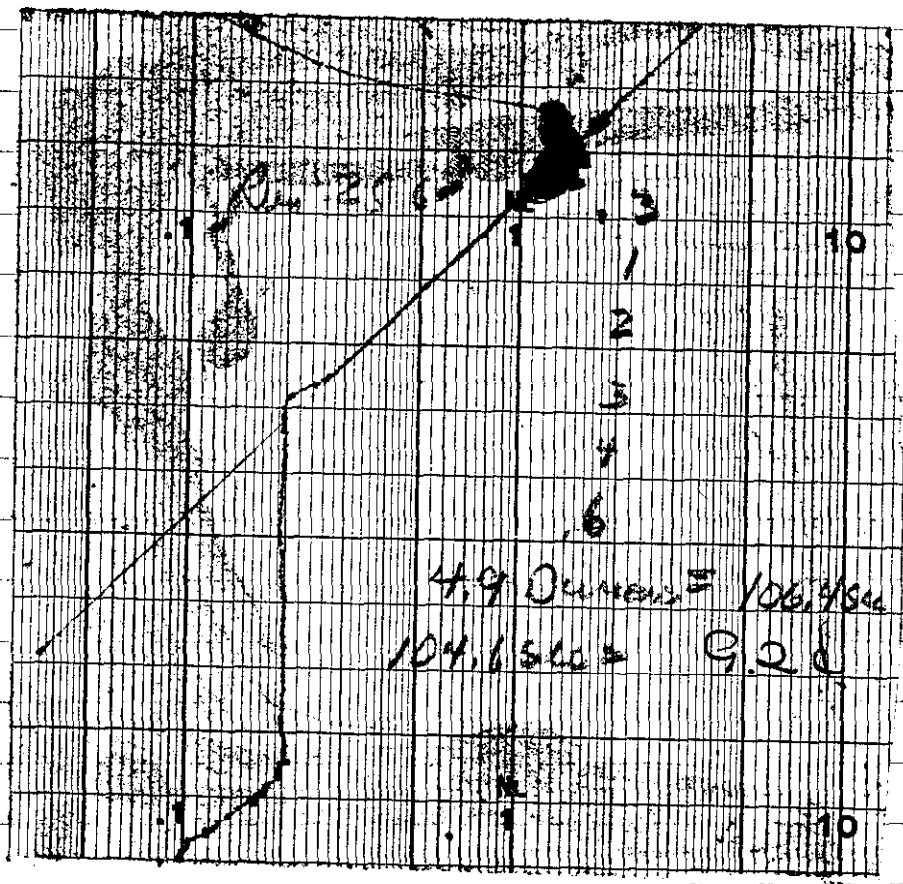
Loading: Same as 253 - except that ½ Fuel Plate 5-9 was inserted in Slot 8 Box 9, in place of 5S8-9.

Critical Conditions: at 1.44 PM.

Log N	.19	Control Blade	11.53
OC-3	74 x 10 x 20	Control Rod	29.03
R-1	4.45 x 600 x 1000	Water Ht	109.7
Water Temp	25.5		

Control Blade pulled to 15.83 to get a period measurement of Fuel worth in Box 9. Slot 8

On this period it took 75 ~~105~~ seconds to go a factor of 2.


Ounces
1
.1
.2
.3
1
10
2
3
4
6
4.9 Ounces = 106.4164
104.6544 = 9.2 g
.1
1
10

Expr. 25-7 Time 1:52 AM Date 23 Jan 1956
Purpose Fuel Evaluation
Box 16 Slot 8
Personnel: MB RS

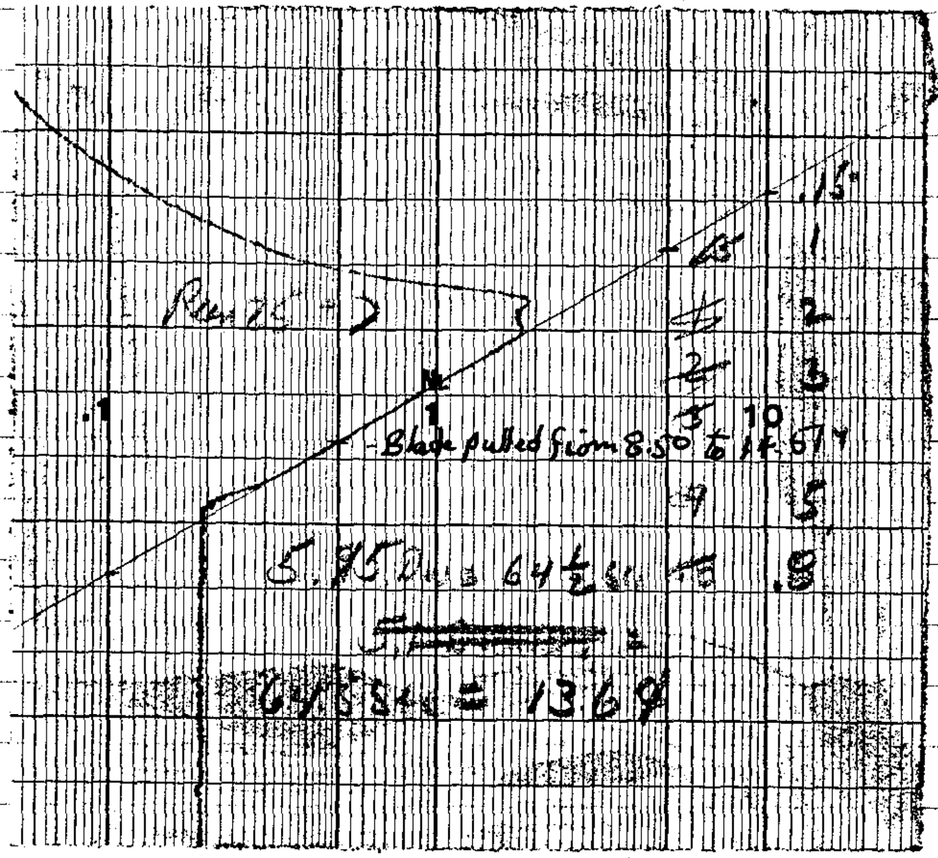
START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Ready by MB
~~Source In~~ Checked by ~~Source No.~~
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start-Up OK'd by MB Time AM Date 23 Jan 1956

Loading: Same as 25-3 except that Fuel ½ plate 5-16 was inserted in slot 8 Box 16 in place of SS ~~#~~ 8-16.

Critical Conditions: at 2.05

Log N	.19	Control Blade	8.50
DC-3	74 x 10 x 20	Control Rod	29.03
R-1	4.2 x 100 x 1000	Water Ht	109.5
Water Temp	25.5		

The Blade was pulled to 14.51 to get a partial period measurement of the worth of fuel in Box 16 slot 8.
While on this period it took 48.4 sec. to go a factor of 2. on DC3.


.1
1
10
Blade pulled from 8.50 to 14.67
5.75 Div = 64½ sec
64.5 sec = 1369

Expr. 26-8 Time 2.25 AM Date 23 Jan 1956
Purpose ~~Reactor~~ Fuel Evaluation
Recheck Zero
Personnel: MB, WRS

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RJ
Start Up OK'd by MB Time 2.25 AM Date 23 Jan 1956

Loading. Same as 25-3

Critical Conditions: at 2:35

Log N	.19	Control Blade	16.56
DC-3	74 X 10 X 20	Control Rod	29.03
R-1	4.4 X 100 X 1000	Water Ht.	109.9
Water Temp	75.		

Expr. 25-9 Time 2.40 AM Date 23 Jan 1956
Purpose Fuel Evaluation
½ plate Slot 8 Box 23
Personnel: MB RJ

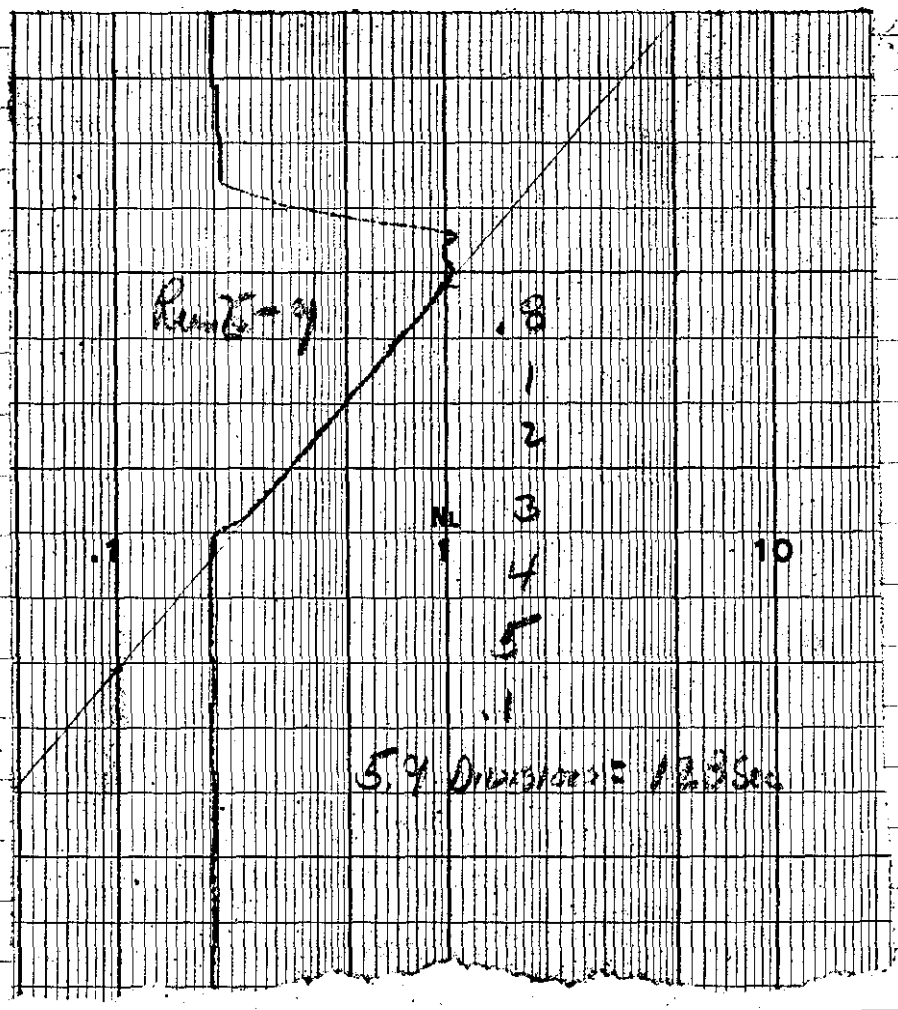
START-UP CHECK LIST
Equipment Checked by RS Tested by RJ
Instrument [illegible] MB
"Source In" [illegible] MB
Emergency [illegible] RJ
Red Light On by RS
Start-Up OK'd by MB Time 2.40 AM Date 23 Jan 1956

Loading. Same as 25-3, except that ½ Fuel Plate 5-23 is inserted in Slot 8 Box 23, in place of SS 8-20.

Critical Conditions: at 2:50 PM.

Log N .19	Control Blade 7.63
DC-3 7.7 X 10 X 20	Control Rod 29.03
R-1 4.45 x 100 x 1000	Water Ht. 109.8
Water Temp 75	

Blade pulled from 7.63 to 11.53 to get a partial (Reactivity) period measurement.
On This period it take 89.4 sec to go a factor of 2 on DC-3.


Run 2 - 4
.8
1
2
3
4
5
1
.1
NL
1
10
5% Damping = 1.23 Sec.

Expr. 25-10 Time 2.59 AM Date 23 Jan 1956
Purpose Fuel Evaluation
Zero Re Check
Personnel: MB, URJ

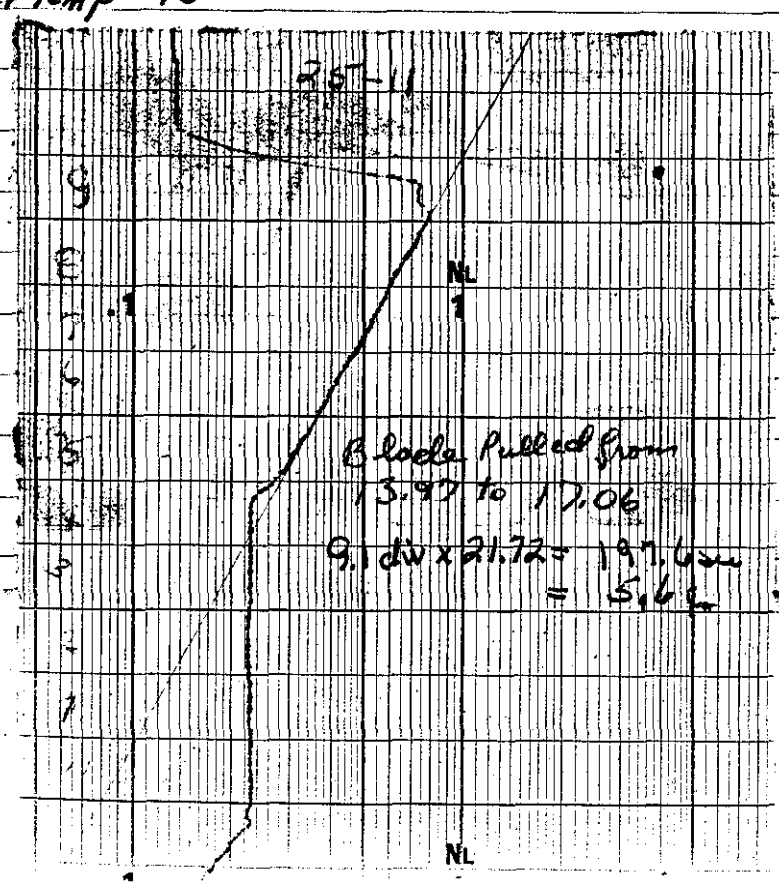
START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safety [illegible] by MB
"Source In" Checked by MB [illegible]
Emergency Equipment & Control Room Checked by RJ
Red Light On by RJ
Start-Up OK'd by MB Time 2.59 AM Date 23 Jan 1956

Loading. Same as 25-3

Critical Conditions at 3.05 :

Log N	.19	Control Blade	17.05
Oc-3	73x10x20	Control Rod	29.03
R-1	43x100x1006	Water Ht.	109.6

Water Temp 75



Expr. 25-11 Time 3.11 AM Date 23 Jan 1956
Purpose Fuel Evaluation
Full Plate. Spt 8 Box 3.
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
Source "In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start Up OK'd by RJ Time 3:10 PM Date 1-23 1956.

Loading - same as 25-3 except full plate 15-8 now in slot 8, box 23.

Critical Conditions at 3:22.

P-1	5.1	Blade	13.97
DC-3	85 (10×20)	Rod	29.03
Log N	2.2	Height	109.0
Temp.	75°F		

Blade pulled to 17.06 for period measurement.
Time for a factor of 2 on DC-3 was 133 sec.
(factor of e is ∴ 181.5 sec.) = 6.0 d.)

Expr. 25-12 Time 3:30 Date 1-23 1956
Purpose Zero Run

Personnel:

START-UP CHECK LIST
Equipment Checked by RJ RJ
Instrument ... RJ
"Source In" Check ... RJ
Emergency ... MB
Red Light On by MB
Start-Up OK'd by RJ Time 3:30 Date 1-23 1956

Loading - same as 25-3.

Critical conditions at 3:40

R-1	445 (100 x 1000)	Rod	29.03
DC-3	74 (10 x 20	Blade	17.88
Log N	18	Water	109.4
Temp.	76°F		

Expr. 25-13 Time 3:50 (AM) PM Date 1-23 1956
Purpose ~~Zero bias~~ Full plate in slot 8, box 9

Personnel:

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by RJ
Instrument and Safety [illegible] and Reset by RJ
"Source In" Checked by RJ Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB AM
Start-Up OK'd by RJ Time 3:50 (PM) Date 1-23 1956

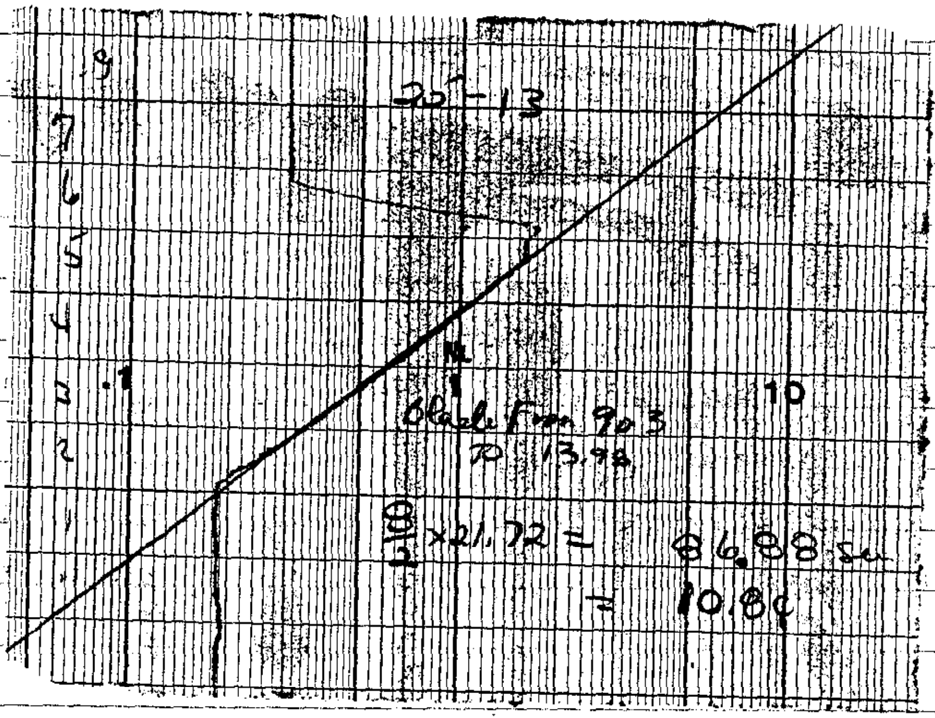
Loading - same as 25-3 except full plate, 25-9 in slot 8, box 9.

*Critical Conditions — 3:59

R-1	4.35 (100x1000)	Blade	~~8.89~~ 9.01
DC-3	73 (10x20)	Rod	29.03
Log N	.18	Water	109.3
Temp.	~~76°F~~ 75°F		

Blade pulled to 13.98 for period measurement.

Time for a factor of 2 on DC-3 ——— 61.5 sec.
(corresponding to a factor of e (period) of 84 sec) = 11 ℓ)


9
7
6
5
4
3
2
.1
1
10
×21.72 =

Expr. 25-14 Time 4:07 AM Date 1-23 1956
Purpose Zero Check

Personnel:

START-UP CHECK LIST

Equipment Checked by RJ Personnel Checked by RJ
Instrument and [illegible] Fuel and Reflector [illegible] RJ
"Source In" Checked RJ
Emergency Equipment [illegible] Heat of Boost Switch by MB
Red Light On by MB
Start Up OK'd by RJ Time 4:07 Date 1-23 1956

Loading - same as 25-3.

Critical conditions : 4:15

Log N	.19	Height	109.3
DC-3	7.4 (10 x 20)	Blade	~~18.90~~ 19.01
P-1	4.5 (100 x 1000)	Rod	29.03
Temp	75.50		

Expr. 26-1 Time 1:20 (PM) Date 1-25 1956
Purpose Fine structure in C.C.C. APPR box
Zero Run
Personnel:

INSTRUMENT CHECK

Date 1-25 1956 Time (AM) (PM) Source No.

Instrument	Volts	Band	Range	Distance	Start-Up Scale
DC-1					
DC-2					
DC-3	—	81	10x20		
Log N	✓		12cm		
R-1	—	6	9x1000 x100		
R-2					
P. M.	✓		800 ✓		

START-UP CHECK LIST

Equipment Checked by DVPW Personnel Check by MB
Instrument and Safeties Checked and Tested by DVPW
"Source In" Checked by DVPW Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by DVPW
Start-Up OK'd by DVPW Time 1:25 (PM) Date 1-25 1956

Loading —

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	13	2	14	4	5	9	7	5	9	7	11	12	11	14	15	8	1	18
material	f	S/S	f	S/S	S/S	f	S/S	f/L	S/S	f	S/S	S/S	f	S/S	S/S	f	S/S	f

Except for slots in the following boxes:

14	which contains	15-1
18		15-2
28		15-3
32		15-4
20		15-7
26		15-8

Critical conditions

Lg N	0.057	Blnk	~19.0
DC-3	88(1x50)	Rod	28.03
R-1	3(50x1000)	Water	109.4
Temp.	76°F		

7.5 plat/box + 3 plates = 340.5 plates

340.5 x 31.1 = 10.59 Kg U-235

17 18
1 10
5 f

Expr. 26-2 Time 2:15 AM (PM) Date 1-25 1956
Purpose Fine structure in APPR elements

Personnel:

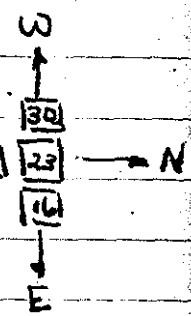
START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
"Scram In" Checked by RJ Scram No.
Emergency Equipment in Control Room Checked by MB
Red Light On by RJ
Start-Up OK'd by RJ Time 2:15 AM (PM) Date 1-25 1956.

Loading - same as 26-1 except APPR element with the "light" plates is in position #23.

Foil Location -

Box Position Slot	Position of foil on Plate	West or East side	Foil #
16-10	7-16	E	2
16-13	11-16	E	14
16-16	8-16	E	3
16-18	10-16	E	4
23-1	APL-1	E	6
23-3	APL-3	E	7
23-4	APL-4	in water between 4 & 5	8
23-6	APL-6	W	10
23-7	APL-7	in water between 7 & 8	11
23-9	APL-9	E	12
23-11	APL-11	E ; center of plate	13
23-13	APL-13	W	16
23-11	APL-11	E; near S edge of plate	15
24-10	7-24	W, near N edge of plate	17
24-10	7-24	W, near center of plate	1



½ first power (LogN=0.74) at 2:36:03

Run conditions:

Water	109.4 cm	DC-3	—
Blade	8.47	R-1	51.5 (1000 x 1000)
Rod	29.03	LogN	2.0
		Temp.	

Expr. 20-15 Time 9:25 (AM) PM Date 1-26 1956

Purpose Zero check

Personnel:

INSTRUMENT CHECK

Date 1-26 1956 Time 9:20 (AM) PM Source No.

Instrument	Trip			Start-Up Scale
DC-1				
DC-2				
DC-3	✓	80	40 x 20	2
Log N	✓		12 sec	
R-1	✓	5.9	.9 x 1000 x 100	
R-2				
P. M.	✓		800V	2

Log N calibration- meter 0.079
Recorder 0.079

START-UP CHECK LIST

Equipment Checked by RJ Power Supplies Checked by RJ

Instrument and Safeties Checked and Set by mB

"Source In" Checked by RJ

Emergency Equipment in Control Room Checked by mB

Red Light On by mB

Start-Up OK'd by RJ Time 9:50 (E) PM Date 1-26 1956

Loading- same as 26-1 (pg 114) except S.S. is now in slot 3, box 3, and full fuel 15-5 now in slot 8, box 43.; full fuel 15-6 now in slot 8, box 38.

Critical conditions

R-1	4.35 (10 x 1000)	Height	109.4
Log N	.18	Blade	13.05
DC-3	74 (10 x 20)	Rod	29.02
Temp	75.5°F		

Expt. 25-16 Time 10:25 (AM) Date 1-26 1956
Purpose Zero check
Personnel:

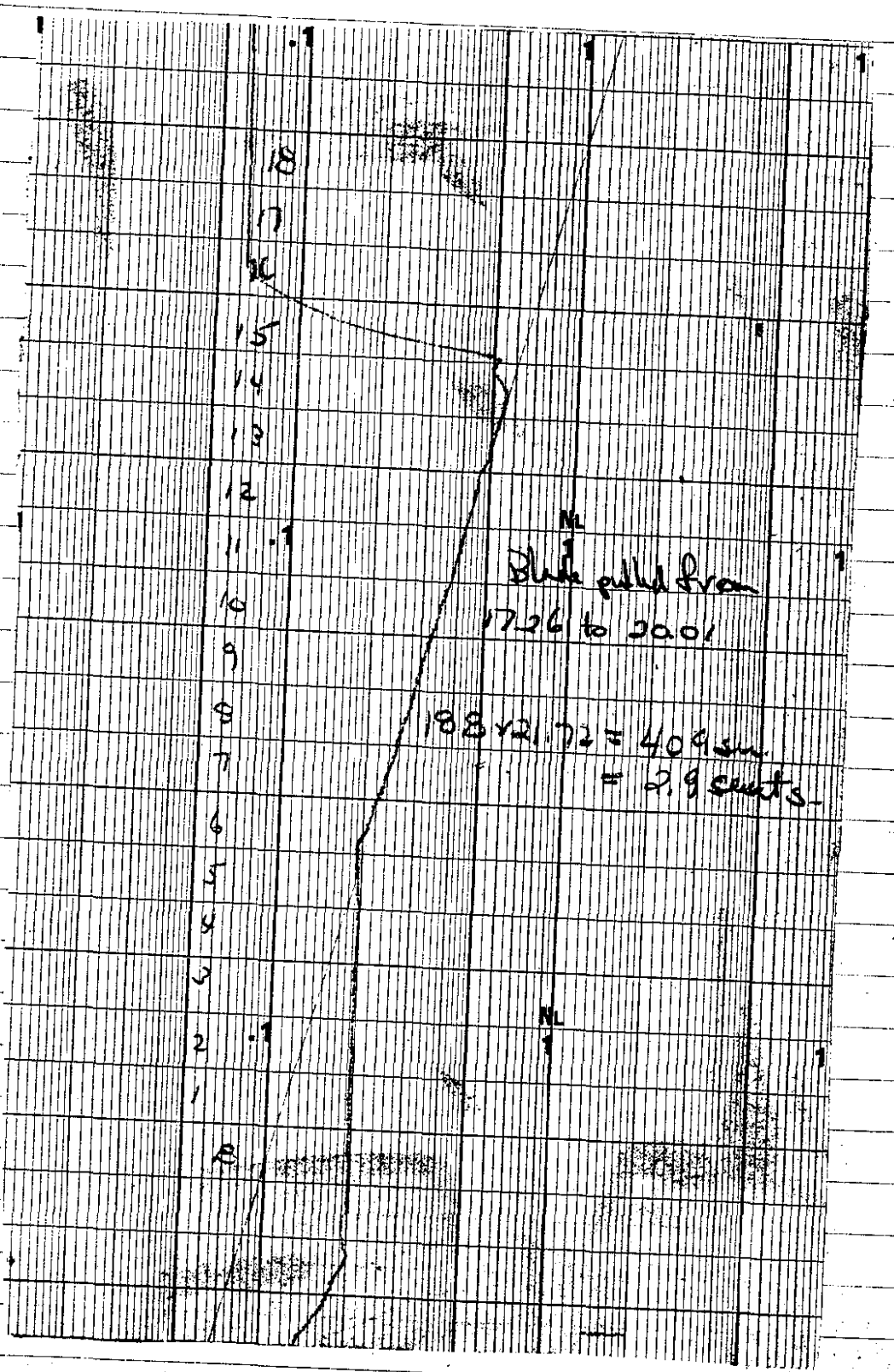
START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by RJ
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by RJ Source I.D.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 10:25 (AM) Date 1-26 1956

Loading – same as 26-1 (p. 114) except S.S. is now in slot 3, box 3 and full fuel 15-5 is now in slot 8, box 43.

Critical conditions at 10:36

LogN	0.19	Height	109.2
DC-3	74.5 (10x20)	Blade	17.26
R-1	4.45 (100x1000)	Rod	29.02
Temp.	~~1092~~	76.5°F	

Blade pulled to 20.01 for calibration.
Time to go a factor of 2 (from 40 → 80 on scale 10x50) was 283.5 sec. or a period of 387 sec. (3.05 ℓ.)


Blank pulse free
1724 to 3001
1083 x 21.72 = 4094 sec.
= 2.9 counts.

Expr. 25-17 Time 10:55 (AM) PM Date 1-26 1956
Purpose Evaluation full → half plate, box 16, slot 8.
Personnel:

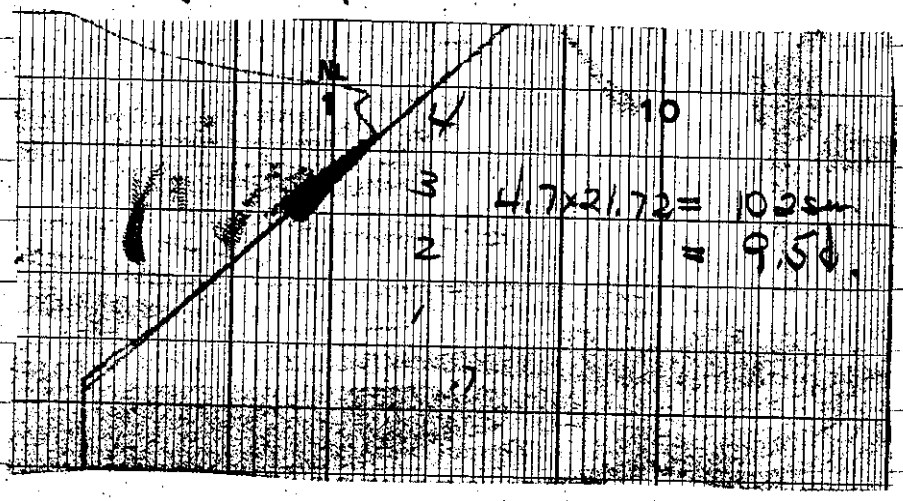
START-UP CHECK LIST
Equipment Checked by: RJ Personnel Check by RJ
Instrument and Safeties Checked and Noted by: RJ
"Source In" Checked by: RJ Source No.
Emergency Equipment & Control Room Checked by: MB
Red Light On by MB
Start-Up OK'd by RJ Time 10:55 (AM) PM Date 1-26 1956

Loading - same as 25-16 except full plate, 6-2, now in plate & half plate, 5-16, in slot 8, box 16.

Critical conditions at 11:00

DC-3	74 (10×20)	Rod	29.02 in.
R-1	4.425 (100×1000)	Blade	9.49
Log N	0.18	Water	109.3 cm.
Temp.	76°F		

Blade pulled to 14.02 for period measurement. Time for a scale factor of 2 on DC-3 was 69.3 sec. corresponding to a period of 94.2 sec. (10.1 ¢)



Expr. 25-16 Time 11:10 AM Date 1-26 1956
Purpose Recheck zero

Personnel:

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by RJ
Instrument and Safety [illegible] and Recorder RJ
"Source In" Checked by RJ Source by
Emergency Equipment [illegible] Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 11:10 PM Date 1-26 1956

Loading same as 25-16.

Critical Conditions: at 11:21

DC-3 74 (10x20 Blade 17.26
R-1 4.4 (100x1000) Rod 29.02 in.
Log N 0.19 Water 109.8 cm.
Temp. 75.

Expr. 25-19 Time 1:20 AM Date 26 Jan 1956
Purpose Recheck Zero
Personnel: MB, RS

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safety Channels and Reset by RS
"Source" Channel by MB Period No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start-Up OK'd by MB Time 1:31 AM Date 26 Jan 1956

Loading: Same as 25-16

Critical Conditions:

Lg N	.19	Control Blade	19.03
Oc-3	74 x 10 x 200	Control Rod	29.02
R-1	4.45 x 100 x 1000	Time	1:33
Water Temp	75	Water Ht.	109.5

Expr. 25-20 1350 AM Date 26 Jan 1956
Purpose Fuel Evaluation
Box 23 slot B
Personnel: MB RS

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset RS
"Source In" Checked by MB Figure No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start-Up OK'd by MB Time 1:35 AM Date 26 Jan 1956

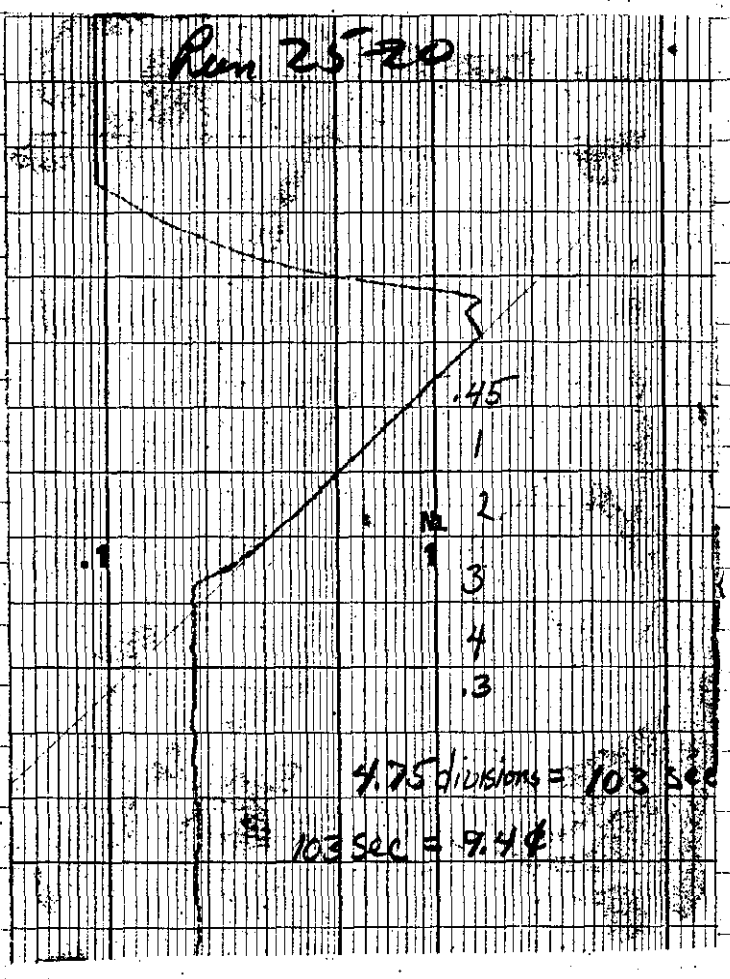
Loading: Same as 25-16, except that Fullplate 6-2 is put into slot B Box 23, ~~instead of~~ in place of 5-23.

Critical Conditions:

Log N	.18	Control Blade	8.55
OC-3	75 X10 X20	Control Rod	29.02
R-1	4.3 x 100 x 1000	Time	1:47
Water Temp	75.5	Water Ht.	109.7

The Control Blade is pulled to 13.01 from 8.55 in order to get a partial period measurement of the reactivity of the added fuel in Box 23, Slot B.

It took OC-3 73 sec to go a factor of 2, which results in a period measurement of 99.7 sec. This is a period worth 9.6 cents.


Run 25-20
.45
1
2
3
4
.3
4.75 divisions = 103 sec
103 sec = 9.4¢

Expr. 25-21 Time 2:00 AM PM Date 26 Jan 1956
Purpose Recheck Zero

Personnel: MB, WRJ

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room checked by RS
Red Light On by RS
Start-Up OK'd by MB Time 2:00 AM PM Date 26 Jan 1956

Loading. Same as 25-16

Critical Conditions

Log N	.17	Control Blade	19.52
OC-3	75.1 10 120	Control Rod	29.02
R-1	4.15 1 mx 1000	Time	2:08
Water Temp	75	Water Ht.	109.5

Expr. 26-22 Time 2.19 AM PM Date 26 Jan 1956
Purpose Fuel evaluation
Full Plate Box 3 slot 3
Personnel: MB RJ

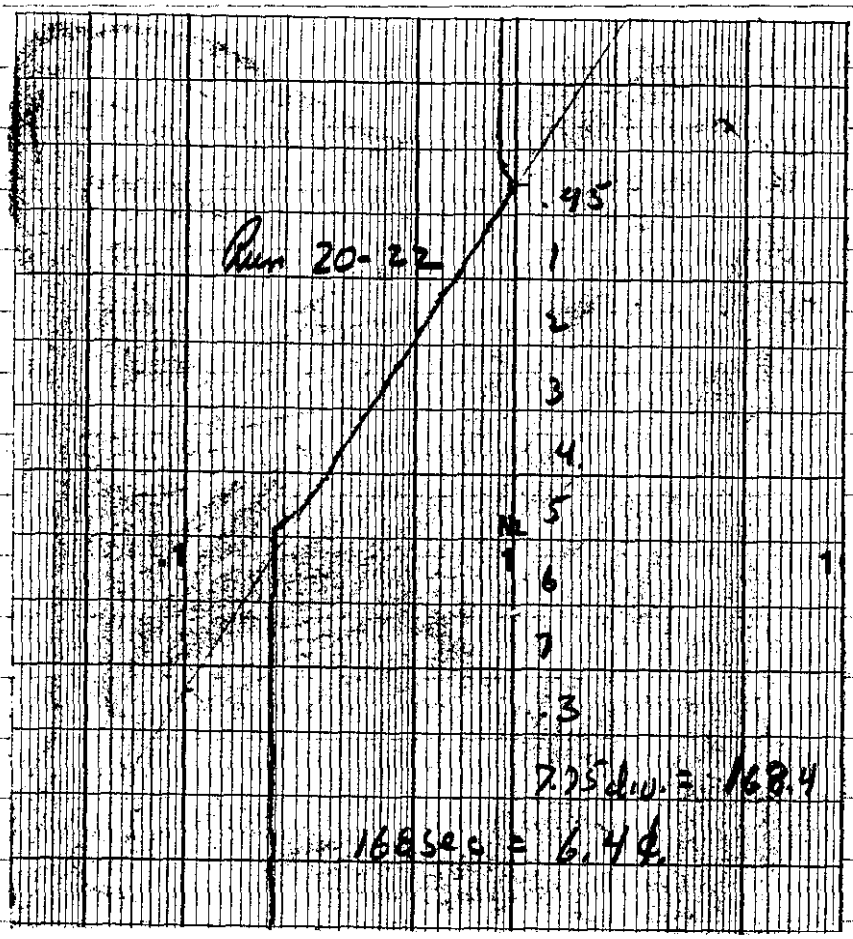
START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by RJ
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ
Start-Up OK'd by MB Time 2:19 AM PM Date 26 Jan 1956

Loading: Same as 25-16, except Full Fuel Plate 14-3 is put in Box 3 - slot 3, in place of Stainless Steel.

Critical Conditions

Log N	.18	Control Blade	15.~~50~~ 33
DC-3	24X10X20	Control Rod	29.02
R-1	4.25X100X1000	Time	2.39
Water Temp	75.	Water Ht	109.8

Control Blade pulled to 20: to get a period measurement from 15.~~50~~ 33 to 20.0
DC-3 took ~~r~~ 120.04 sec to go a factor of 2, which is equivalent to a period of ~~Stan~~ 164 sec period, worth 6.6 cents in Reactivity.


Run 20-22
.95
1
2
3
4
5
6
7
.3
.95 d.w. = 168.4
168 secs = 6.4 ℓ.

Expr. 25-23 Time 2:54 AM (PM) Date 26 Jan 1956
Purpose Fuel Evaluation
APPR Type Plate. Box 23, Slot 8.
Personnel: MB RS

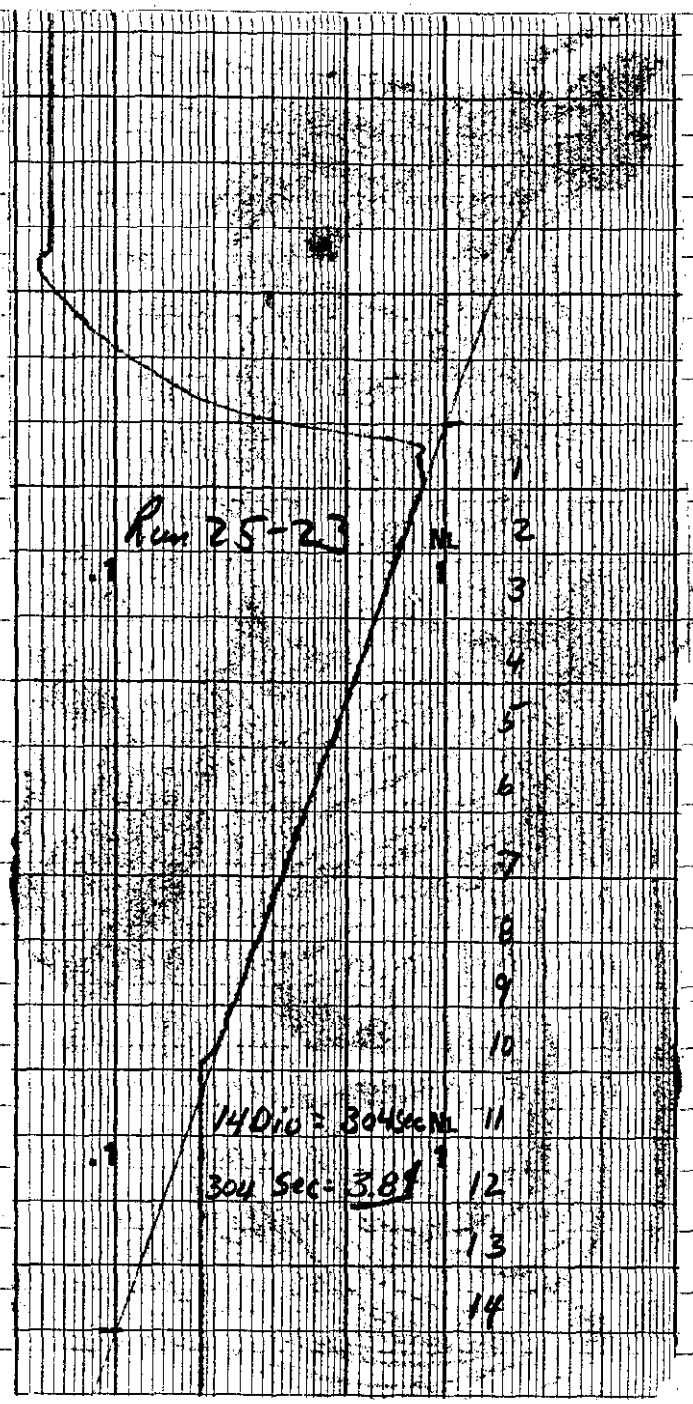
START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start-Up OK'd by MB Time 2:54 AM Date 26 Jan 1956

Loading: Same as 25-22, except that APPR Plate APL-8 is in Box 23 Slot 8, instead of ½ plate 5-23.

Critical Conditions:

Log N	.18	Control Blade	16.65
DC-3	74 x 10 x 20	Control Rod	29.02
R-1	4.3 x 100 x 1000	Time	3.07
Water Temp	75.	Water Ht.	109.7

Blade pulled to 20.01 from 16.65, to get a period Measurement.
DC-3 took 214 sec to go a factor of 2 on a period of 292 sec. This is worth 4 ¢ in reactivity.


Run 25-23
.1
1
2
3
4
5
6
7
8
9
10
11
12
13
14
140in = 304sec
304 sec = 3.8'

Expt. 25-24 Time 3.15 AM Date 26 Jan 1956
Purpose Zero Recheck

Personnel: MB. WRS

START-UP CHECK LIST.
Equipment Checked by RS Personnel Checked by RS
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No
Emergency Equipment Control Room Checked by RS
Red Light On by RS
Start Up Ordered by MB Time 3.20 AM Date 26 Jan 1956

Loading. Same as 25-22.

Critical Conditions.

Log N	.18	Control Blade	15.69
DC-3	74. x10x20	Control Rod	29.02
R-1	4.35x10^4x1000	Time	3:32
Water Ht Temp	75	Water Ht.	109.7

Expr. 25-25 Time 3.35 AM Date 26 Jan 1956
Purpose Fuel evaluation
Full plate Box 23. Slot 8
Personnel: MB RS

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
RS
Instrument and Safeties Checked and
"Source In" Checked
Emergency Equipment in Control Room, Checked by RS
Red Light On by RS
Start-Up OK'd by MB Time 3.35 AM Date 26 Jan 1956

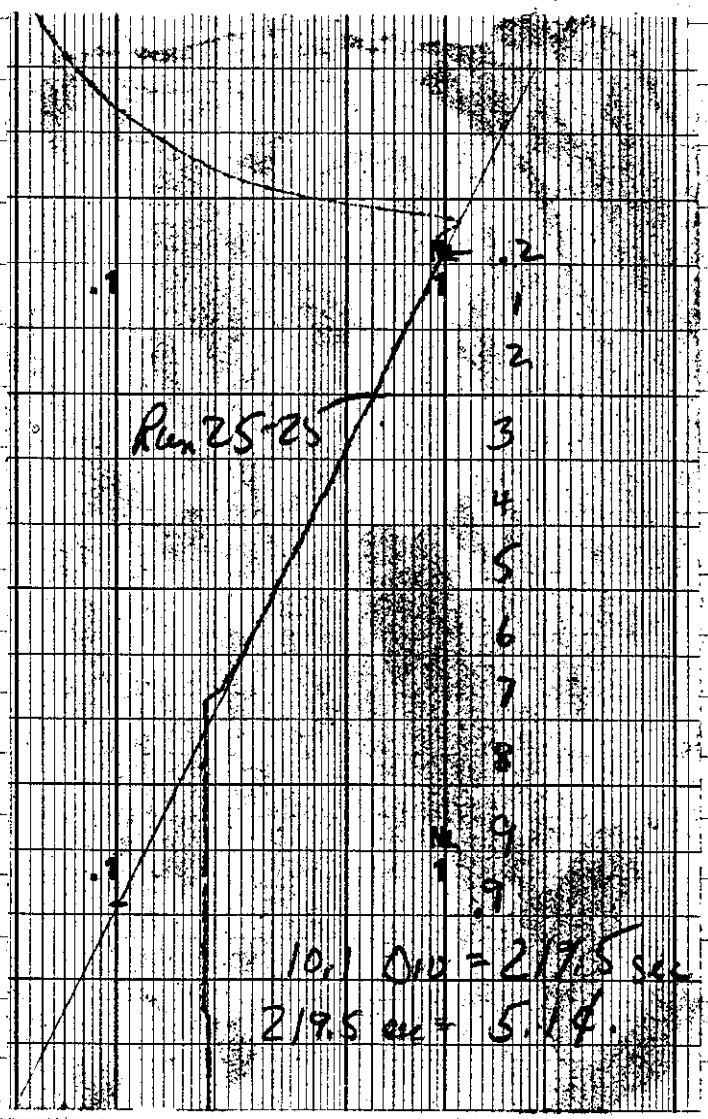
Loading: Same as 25-24 except that Full Fuel Plate 6-2 is in slot 8 Box 23, instead of ½ plate 5-23.

Critical Conditions

Log N	.18	Control Blade	5.97
OC-3	8.2 X 10 X 20	Control Rod	29.0 z
R-1	4.6 X 100 X 1000	Temp	3.46
Water Temp	75	Water Height	110.1

Blade pulled to 9.0 to get a period measurement.

OC-3 took 155 sec to go a factor of 2, this is a period of 211.7 sec, which is 5.2 ¢ in reactivity.


.1
.2
1
1
2
3
4
5
6
7
8
9
1
.1
Run 25-25
10.1 Dia = 2175 sec
219.5 sec = 5.14.

Expr. 25-26 Time 355 AM Date 26 Jan 1956
Purpose Recheck Zero

Personnel: MB. WRJ

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset MB
"Source In" Checked by MB
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start Up OK'd by MB Time 356 AM Date 26 Jan 1956

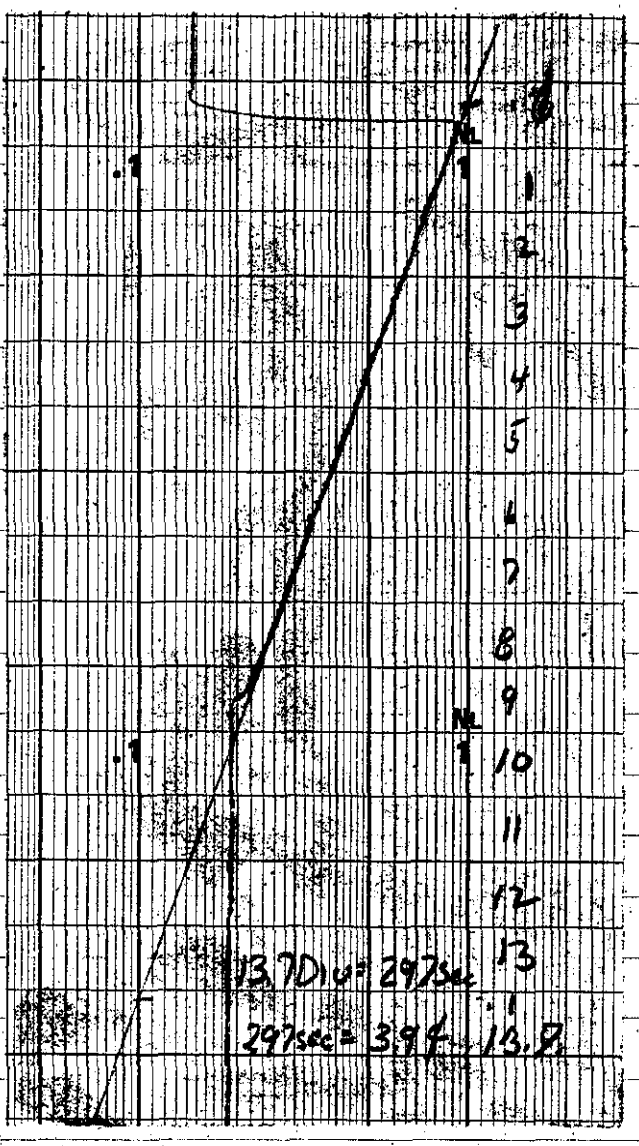
Loading: Same as - 25-22.

Critical Conditions

Log N	.18	Control Blade	16.05
DC-3	75 x 10 x 20	Control Rod	29.02
R-1	4.35 x 100 x 1000	Time	4.11
Water Temp	75	Water Height	109.5

Control Blade pulled to to get a reactivity measurement.

DC-3 took 199 sec to go a factor of 2, this is a 272 period, worth 4.24.


.1
1
.1
1
13.7D/v = 297sec
297sec = 3.9 13.7

Expr. 26-3 Time 9:15 AM Date 1-27 1956
Purpose Fine structure in light-loaded
APPR box - zero run.
Personnel:

INSTRUMENT CHECK

Date 1-27 1956 Time 9:15 AM PM Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	80	10×20	3" T
Log N	✓		12cm	
R-1			.5×100 ×100	
R-2				
P. M.	✓		800V	1"

Log N 0.079, meter
Calibration 0.076, recorder.

Adjust zero on Log N. gnd = .001
40 = .1

START-UP CHECK

Equipment Checked by Dwm Check by Dwm
Instrument and Safety Rods Checked by Dwm
"Source In" Checked by MB
Emergency Equipment in Control Room Checked by Dwm
Red Light On by Dwm
Start-Up OK'd by MB Time 930 AM Date Jan 27 1956

Loading: Same as 25-22 except for two plates removed for foil loading. 6-2 put in Box 24 Slot 10
6-4 put in Box 16 Slot 13

CRITICAL CONDITIONS:

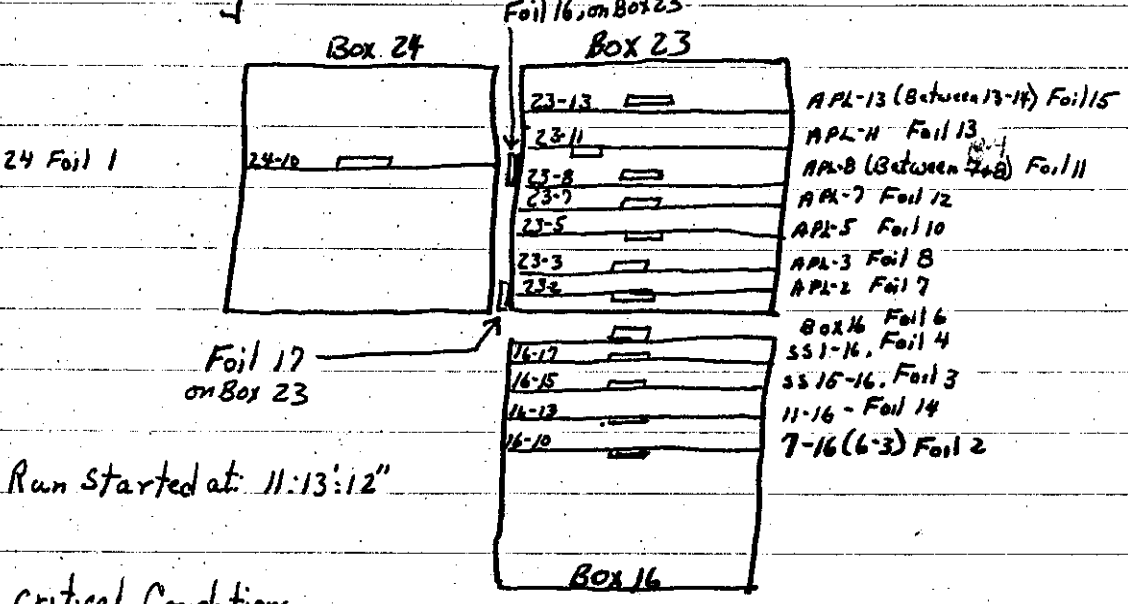
Water Height	109.5	R-1	4.5 × 50 × 800
" Temp	75°F	Log N	.09
Cnt Rod	29.02	DC-3	76 × 10 × 10
" Blade	17.45		

Expr. 26-4 Time 10-58 (AM) PM Date 27 Jan 1956
Purpose Fine Structure in Light Loaded
APPR- Box- Foil Run
Personnel: MB -WRS

START-UP CHECK LIST
Equipment Checked by WRS Personnel Check by RS
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by RS
Red Light On by RS
Start-Up OK'd by MB Time 10.58 (AM) PM Date 27 Jan 1956

Loading: Same as 25-22, except that the APPR Box is in ~~Sto~~ Position 23.

Foil Loading



Run Started at: 11:13:12"

Critical Conditions

Log N 2.0
D-C-2 ~~70~~ 69 X10X5
P-1 5.55 X1000X1000
Water Temp 76.5°F

Control Blade 10.58
Control Rod 29.02
Water Height 109.6

Expr. 27-1 Time 2'15 ~~AM~~ PM Date Jan 27 1956
Purpose Zero Run - Thermal Fission Rate
Personnel: WRJ DWM

START-UP CHECK LIST
Equipment Checked by DWM Personnel Check by DWM
Instrument and Safeties Checked and Reset WRJ
"Source In" Checked by WRJ Source No. —
Emergency Equipment in Control Room Checked by DWM
Red Light On by DWM
Start Up OK'd by WRJ Time 2'15 ~~AM~~ PM Date Jan 27 1956

Loading: Same as 25-22 except 5 plates -- fuel plates exchanged for half plates

	5-3	Removed from Box 3 Slot 8	Inserted	15-6
	5-7	"	#7 "	15-11
WRJ 1-30-56	5-11	"	#11 "	15-12
	5-35	"	35 "	15-14
	5-39	"	39 "	15-15

~~Crit Cond.~~ Added 2 2.05" x .026" cadmium discs taped on each side of 7-23. (Box 23 Slot 10)

Crit. Conditions

Blade	19.99	DC.3	47 x 10 x 20
Rod	29.02	Log N	0.13
Water Ht	109.3	K-1	2.7 x 100 x 1000
Temp	75 °F		

Expr. 27-2 Time 2:40 AM (PM) Date 1-27 1956
Purpose Determination of the Thermal Fission Ratio.
Personnel:

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by MB
Instrument and Safeties Checked and Reset by RJ
"Source In" Checked by RJ Source No:
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by RJ Time 2:46 AM (PM) Date 1-27 1956.

Loading - same as 27-1 except plate 15-16 now in slot 8, box 30
Also the following special plates:
F-1 is Cd covered, has foil #201, & is in slot 10, box 23.
F-2 is bare, " " #202, " " " 10, " 3
F-6 " " " " 203 " " " 10, " 37.

Standardizing Butcher foils are located:
#1, in corner position A-7 in upper grid (
#2, in its usual west-skirt position.

He final power at 2:59:24.
Run conditions (at 15 min.)
Water 109.1 cm. Temp 75°F
Blue 8.36 DC-2 771 (1 x 50)
Red 29.02. R-1 5.6 (1000 x 1000)
Log N 2.0

Expr. 27-3 Time 4:30 AM (PM) Date 1-30 1956
Purpose Zero Check.

Personnel: P.M.; M.B

INSTRUMENT CHECK

Date 1-30 1956 Time 4:30 AM (PM) Source No. ____

Instrument	Trip Value	Scale	Source Distance	Start-Up Counts
DC-1				
DC-2				
DC-3	✓	70	10x20 5"	
Log N	✓		12 cm.	
R-1	✓	5.5	.8 x 1000 x 100	
R-2				
P. M.	✓		800 v content	

Log N calibration: .079 — meter
.081 — recorder.

No zero adjustment necessary

START-UP CHECK LIST

Equipment Checked by D.M. Personnel Checked by D.M.
Instrument and Safeties Checked and Set by M.B. D.M.
"Source In" Checked by D.M. Source No. ____
Emergency Equipment in Control Room Secured by M.B.
Red Light On by M.B.
Start-Up OK'd by D.M. Time 4:30 AM (PM) Date 1-30 1956.

Loading - same as 27-1 except Cd disks are on both sides of 7-3 (slot 10, box 8) and 7-23 (slot 10, box 37) instead of at slot 10, box 23.

Run conditions — Super (wave out)

DC-3	Blank	0.00
R-1	Rod	29.02
Log N	Water	109.5
Temp	Super by	+/- 5¢.

Expr. 27-4 Time 5:45 AM PM Date 1-30 1956
Purpose Determination of Thermal Fission Ratio. - part II
Personnel:

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by MB
Instrument and Safety [illegible] Set and Reset by: DM
"Source In" Checked by DM Source No.
Emergency Shutdown Control Room Checked by MB
Red Light [illegible] MB
Start Up Ordered by DM Time 5:45 AM PM Date 1-30 1956

Loading - same as 27-3 except full plate 15-Ub removed from slot 8, box 30 & replaced by 5-30.

Foil locations:

Box	Slot	Fuel Plate	Foil #	Bare or Cd Covered
37	10	#516	205	Cd covered
23	10	#511 (F-2)	206	Bare
3	10	# F-1	204	Cd covered.

Pc final power at 5:59:08 pm.

Run conditions - (at 15 minutes)

DC-3	—	Height	109.4
R-1	5.3 (1000 x 1000)	Blade	11.45
DC-2	71 (1 x 50)	Rod	29.03
$\log N$	2.0		

Twenty minute exposure.

Expr. 27-5 Time 8 30 AM (CST) Date 30 Jan 56
Purpose Flux peaks in Core Corners, Also Determination of % Thermal Fissions
Personnel: WRJ, DWM

START-UP CHECK LIST
Equipment Checked by DWM Personnel Check by RS
Instrument and Safety Channels Checked by DM
"Source In" Checked by DM Source No.
Emergency Equipment [illegible] Checked by RS
Red Light On by RS
Start-Up OK'd by DM Time 8 30 AM (CST) Date 30 Jan 1956

Note: For This Experiment the voltage on the photomaltiplier tube was reduced to ~~730~~ 740 v.

Loading: Same as 27-4, ~~except that 1 Fuel Plate was put in to Box 7, slot 10, in place of Full Fuel Plate 15-11~~

Critical Conditions

Log. N.	4.0	Control Blade	10.60
OC-2	77 X 10 110	Control Rod	29.02
Water temp.	75	Water Ht	109.8

Foil Positions

Position Box	Position Slot	Plate #	Al Catcher Foil #	Remarks
37	-10	F-1	208	Cd Covered
23	-10	F-2	207	Bare
12	-1	617	C-51 ~~50~~ 52 26 25 → N	
11	-1	618	C-8	on outside Near Corner
5	-18	619	C-20	" " " "

Position	Plate #	Al Catcher Foil #	Remarks
5-16	616	C-15	on outside near Corner
5-10	621	C-47	" " " "
5-3	614	C-46	" " " "
5-1	613	C-53	" " " "

DWM

Clock started at: 8:49:37" (1.45 on Log N meter)

144

Expr. 28-1 Time 5:30 AM (PM) Date 1-31 1956

Purpose Effect of distributing boron — zero run.

Personnel:

INSTRUMENT CHECK

Date 1-31 1956 Time 5:30 AM (PM) Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
SCR				
DCA				
S-P	—	75	10×20 3"	
Log N	—	70		
R-1	—	55	.8×1000 ×100 contact	
R-2				
P. M.	—	BOGY	— 1"	

Log N calibration — .081 meter
.083 Recorder.

START-UP CHECK LIST

Equipment Checked by RJ Personnel Check by MB

Instrument and Safeties Checked and [illegible] RJ+MB

"Source In" Checked by RJ [illegible]

Emergency Equipment in Control Room Checked by MB

Red Light On by MB

Start-Up OK'd by RJ Time 5:50 AM (PM) Date 1-31 1956

Loading — (complete 9½ plus 12 half plates plus 1 full boron per box)

slot #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
series	13	2	14	4	4	9	7	5	9	7	6	12	11		15	8	1	10
material	f	½	f	½	f	f	½	½	½	f	f	½	f	B	½	f	½	f.

Except:

slot 8 box	now contains.	slot 8 box	now contains.
3	15-6	+ 20	15-7
+ 7	15-11	+ 26	15-8
+ 11	15-12	28	15-3
14	15-1	32	15-4
18	15-2	— 35	15-14
43	15-5	— 39	15-19

Loading (cont.)

also the following plates have been substituted because of bulging.

Removed	Inserted
5-6	H-961
7-18	H-20X
11-18	#378

Reactor quite sub-critical.

ok)

Expr. 28-2 Time 7:30 (A.M.) Date 1-31 1956
Purpose Zero Run

Personnel: RJ, MB

START-UP CHECK LIST

Equipment Checked by RJ Personnel Checked by MB
Instrument and Safeties Checked and [illegible] RJ
"Source In" Checked by RJ [illegible]
Emergency Equipment [illegible] Control Room [illegible] by MB
Red Light On by MB
Start Up OK'd by RJ Time 7:30 (A.M.) Date 1-31 1956

Loading - same as 28-1 except full fuel 6-32 and 4-2 exchanged for 5-30 + 5-16 respectively.
(Now, complete 9½ plus 14 Half plates)

Critical Conditions -

DC-3	63 (10x20)	Blade	0.00
R-1	3.7 (10x100)	Rod	16.98
Log N	.16	Water	109.5
Temp	75°F		

Mass U^{25} $9\frac{1}{2} \times 1.4$ Kg + $15.5 \times 14 \times 10^{-3}$ Kg. = 13.518 Kg.

Mass Boron = $45 \times 1,887$ gms = 85 gms

Blade at 0.00 worth ~~25~~ 265 ¢ or ~ ~~62~~ 67 gm

Rod at 16.98, worth ~ ~~28~~ 28 ¢ or ~ ~~7~~ 7 gm

Corrected Mass = 13,518 gms - ~~64~~ 71 gms ~~13.454~~ 13.447 Kg
13.44

Expr. 28-3 Time 8:25 AM Date 21 Jan 1956
Purpose To The effect of Distributing Boron
Personnel: RJ. MB

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrumentation Checked and Tested by MB
"Source In" Checked by MB Source No.
Emergency Exit Lights and Room Checked by RJ
Red Light On RJ AM
Start-Up OK'd by MB Time PM Date 195

Loading

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Series ~~Type~~	13	2	14	8*	4	9	7	3	9	7	6	12	11	8*	15	B	1	10
Type ~~Series~~	f	SS	f	8/2	f	f	SS	f	SS	f	f	SS	f	B	SS	f	SS	f

* In Boxes 1-3-5-6-8-10, 12-14-16-18-20-22-24-26-28-30-32-34-36-38-40-41-43 (here ~~are~~ are Boron 1/2 plates in slots 4+14 ~~in~~ (a total of 23 Boxes)
In all other boxes (22 boxes) there is a full Boron * Plate in slot 14, and SS-4 in slot 4.

Mass U^{235} 10 x 1.4 Kg = 14. Kg
Mass Boron ~~46~~ 46 x 1884 = 85 gms
Critical Conditions: (Super -
Log N .16 Control Blade 0.0c
OC-3 55 x 10x10 Control Blade 28.98
R-1 2.9 x 00 x 000 Water Height 88 cm
Temp

Expr. 28-4 Time 8.48 AM Date 31 Jan 1956
Purpose The effect of Boron Distribution.

Personnel: MB, RJ

START-UP CHECK LIST
Equipment Checked by RJ Personnel Check by RJ
Instrument and Safeties Checked and Tested MB
"Source In" Checked by MB Source No 1
Emergency Equipment in Control Room Checked by RJ
Red Light On by RJ
Start-Up OK'd by MB Time 8.48 AM Date 31 Jan 1956

Loading: Same as 28-3 except Series "5" ½ Fuel plates were substituted for Series "3" Full Plates in slot 8 in the following 9 Boxes: 7, 9, 11, 21, 23, 25, 35, 37, 39.

B

Mass 44.000gms - 9 x 155 = ~~13.605 Kg~~

= 13.861 Kg.

Criticat Conditions : Susp.

Log N	.55	Control Blade	00.
DC-3	50 x 10 x 50	Control Rod	28.98
R-1	5.5 x 20 x 1000	Water Height	92.6
Water Temp	74.5		

Expr. 28-5 Time 9:10 AM Date 31 Jan 1956
Purpose The Effect of Boron Distribution
Personnel: MB, RJ

START-UP CHECK LIST
Equipment Checked by RS Personnel Check by RJ
Instrument [illegible] Loaded and Reset by MB
Source In [illegible] MB Source No.
Emergency [illegible] and Room Checked by RS
Red Light On by RS
Start-Up OK'd by MB Time 9 10 AM Date 31 Jan 1956

Loading: Same as 28-3 except Series 5 ½-fuel Plates were substituted for Series 3 full Plates in Slot 8 in the following 13 Boxes. 7-8, 9, 11, 18, 21, 23, 25, 28, 35, 37, 38, 39.

Mass = 14. Kg - 13 x 15.5 gms [redacted] = 13.798 Kg
= 13.793

Critical Conditions:

Log N	.20	Control Blade:	8.39
Oc-3	4.7 x 100 x 1000	Control Rod:	28.98
R-1	78 x 10 x 20	Water Height:	109.7
Temp	74.5 °F		

Corrected Mass:
Blade from 8.39 - 29 = ~~78~~ 194 or ~~45~~ 51 gms
Corr. Mass = ~~13.795~~ Kg.
13.742

Boron redistribution value in 23 Boxes (Exp 28-2+5) = ~300 gms

150

Expt. 29-1 Time 9:00 (AM) PM Date 2-6 1956

Purpose Zero Run with Three boron.

Personnel: DW, DM, MB.

INSTRUMENT CHECK

Date 2-6 1956 Time 9:00 (AM) PM Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	—	69	10x20	
Log N	~		12"	
R-1	~	5	.8x1000	
R-2			x100	
P. M.	—		800V ; building alarm rung when P.M. was scrammed	

START-UP CHECK LIST

Equipment Checked by DW Personnel Check by DM

Instrument and Safeties Checked and Reset by DW + MB

"Source In" Checked by DW Source No.

Emergency Equipment in Control Room Checked by DM

Red Light On by DW

Start-Up OK'd by DW Time 9:10 (PM) Date 2-6 1956

Loading —

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
material	f	f	f	B	f	f	f/2	f	B	f	f	f	f	B	f	f	f	f

Loading except for slot 15, boxes 34 & 35 which contain half plates.

Critical Conditions —

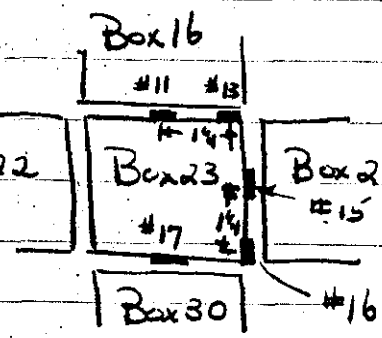
DC-3	81 (10x10)	Height	109.5
R-1	5.8 (50x1000)	Rod	29.00
LogN	0.13	Bank	8.0

Expr. 29-2 Time 11:20 (AM) PM Date 2-6 1956
Purpose Fine Structure with Dy in 3 boron loading
Personnel: D.M, M.B, J.L.

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by MB
Instrument and Safetys Checked and Reset by DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DM Time 11:20 (AM) PM Date 2-6 1956

Loading - same as 29-1.

Box	slot	Foil Location	Dy foil #
23	9		
	8		#3
	7	1"	#10
	6		#6
	5		#2
	4		#8
	3		#4
	2		
	1		
18	5		
f	5		
16	18		
	17		#12
	16		
	15		#1
	14		#14
	13		
	12		#7
	11		
	10		
	9		#5 (Cd covered)



No standardizing catcher foils.
Foils #3, #8, #12, & #17 are normalizing foils for previous run.

1/e power at 11:35:48

Run conditions at 15 minutes.
DC-2 55 (10x20) Blade 10.56
R-1 5.4 (10 turns) Rod 29.00
Log N 2.0 Water 109.8
Temp. 64°F
(heat was off over week-end)

20 minute exposure.

Expr. 30-1 Time 8:45 PM Date 2-7 1956
Purpose Critical Mass with APPR rods.

Personnel: DW, DM, JL, MB

INSTRUMENT CHECK

Date ____ 195__ Time ____ AM PM Source No. ____

Instrument	Trip Valve	Scale	Source Distance	Start-Up Scale
DC 1				
DC 2				
DC 3	✓	73	10×20	contact
Log N	✓		12cm	
R-1	✓	5	.8 ×1000 ×100	
R-2				
P. M.	✓	800V	1"	

START-UP CHECK LIST

Equipment Checked by MB Panel Lights by DW
Instrument and Safety Circuits Tested by DW & DM
Source Installed by DW
Emergency Equipment in Control Room Ready by DM
Red Light On by JL
Start-Up OK'd by DW Time 8:45 PM Date 2-7 1956

Loading:

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
materid	f	f	f	f	f	f	$\frac{f}{2}$	f	$\frac{s}{5}$	f	f	f	f	$\frac{s}{5}$	f	f	f	f

complete loading of 15 1/2 fuel / box.
APPR rods in full in five normal position (9, 21, 23, 25, 32)
Only center rod has fuel on bottom (14 1/2 plates)
Except for slot 15, box 34 & 35 which contains half-plates.

Reactor sub-critical; with source in, blades & rod out
log N got up to 0.02.

Expr. 30-2 Time 9:45 (AM) PM Date 2-7 1956

Purpose Critical Mass with APPR rods all 5 rods in full

Personnel: DM, JL, MB

START-UP CHECK LIST

Equipment Checked by MB JL Personnel Check by MB

Instrument and Safeties Checked and Ready DM

"Source In" Checked by DM Source No.

Emergency Equipment in Control Room Checked by JL

Red Light On by JL

Start-Up OK'd by DM Time 9:45 (AM) PM Date 2-7 1956

Loading:

slot 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

f f f f f f f/2 f 5/5 f f f f 5/5 f f f f

boxes 1,3,5,6,8, ... 43,45 contain full fuel.

plus in slot 14: boxes 7, 11, 35 + 39 contain full fuel

& boxes 3, 4, 15, 17, 29, 31, 42 + 44 contain half fuel

there is now ~~19.581~~ 628 kg. U235 in the core at 40 boxes.

(~~628~~ full plates, 48 half plates)

(APPR ~~22.812~~ kg for a 45 box loading.)

Critical conditions:

DC-3	44 (10×20)	Blade	19.60
R-1	6.7 (50×1000)	Rod	29.00
LogN	0.144	Water	109.5
Temp.	63°F		

2)

plate a/plate

$(52 \times 31.1 = 20.277) \times \frac{45}{40} = 22.81$ Kg U-235

DUDO

Expr. 30-3 Time 12:45 AM PM Date 2-7 1956
Purpose Determination of interaction of fuel sections of "in" APPR rods
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by JM
Instrument and Safeties Checked and Tested by JL
"Source In" Checked by JL Start-up No
Emergency Equipment & Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by JL Time 12:45 AM PM Date 2-7 1956

Loading -

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	f	f	$\frac{S}{S}$	f	$\frac{S}{S}$	f	$f_{/2}$	f	$\frac{S}{S}$	f	f	$\frac{S}{S}$	f	f	$\frac{S}{S}$	f	f	f

Complete loading of 12½
APPR rods completely in without fuel sections attached in positions 9, 21, 23, & 25.
APPR rod full out with fuel section loaded as listed above in position 37.

Reactor too reactive: critical conditions:
with blades in, rod out, water at 84.4, source out
$L_g N$ 0.085

Expr. 30-4 Time 1:15 (AM) PM Date 2-7 195 6
Purpose Interation of fuel sections — zero run.
Personnel: DM, JL, MB

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by MB
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DM Time 1:15 (AM) PM Date 2-7 195 6

Loading — same as 30-3 except 12, full fuel plates pulled from slot 17 in boxes: 1, 35, 14, 16, 18, 28, 30, 32, ~~36, 37, 39~~ 41, 43, 45.

Reactor super-critical at 88.0 cm
critical at 87.6 cm.

Expr. 30-5 Time 1 40 PM Date Feb. 7 1956
Purpose Fuel Interchanges on Rods.
Zero Run 3 Ec + 1 C Rods In.
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safedies Checked and Set by JL
Source In Checked by MB
Emergency Equipment in Control Room Checked by DWM
Red Light On by —
Start-Up OK'd by MB Time 1 40 PM Date Feb 7 1956

Loading: Same as 30-3 with fuel pulled from
S/o + 17 from Boxes 1, 3, 5, 8, 12, 14, 16, 18, 20, 24, 28, 30, 32
36, 40, 41, 43, 45
12½ × 44 − 18 = ~~482~~ 494.5 plates, → ~~14.99~~ 15.379 kg in core U-235
~~14.99~~ × 45/44 = ~~16.46~~ 16.89 kg equiv. U-235

Critical Conditions:
Water Ht 89.5 cm Kg. Log N 0.14
Blade .01
Rod 29.02
APPR Ec Rod 23.99
" Central " 20.04

APPR Boron Section Numbers

Stamped	Red Paint
1	1
2	3
3	2
4	5
5	6
6	4

2 00

Expr. 30-6 Time ~~2 00~~ PM Date Febr. 7 1956

Purpose

Zero Run 3X + 1C APPR Rods

Personnel:

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by JL

Instruments and Switches Checked and Reset by JL

"Source In" Checked by MB Source No. —

Emergency Equipment in Control Room Checked by DWM

Red Light On by ✓

Start-Up OK'd by MB Time 2 00 PM Date 2-7 1956

Loading: Same as 30-3 with Fuel Removed from 24 boxes

sht 17 (1, 3, 5, 6, 8 ..... 38, 40, 41, 43, 45)

$12\frac{1}{2} \times 44 - 24 = \overset{488.5}{\cancel{476}}$ plates → $\overset{15.192}{\cancel{14.804}}$

U-235

$\times \frac{45}{40} = \overset{16.67}{\cancel{16.25}}$ kg U-235

U-235

Critical Cond

Water Height 93.2 cm Log N 0.25

BCalc Rod	} Sum	.01
X Appr Rod		29.02
C " "		.04
		23.99

APPR Control Rod numbers

Rod 1 in box 25

Rod 4 in box 23

Rod 5 in box 21

Rod 3 in box 9

Expr. 30-7 Time 2:30 PM Date 2-7 1956
Purpose
Zero Run 3 x + ½ C APPR Rod
Personnel: Dunn MB J.L.

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by MB
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No. —
Emergency Equipment in Control Room Checked by Dunn
Red Light On by ✓
Start-Up OK'd by MB Time 2:30 PM Date 2-7 1956

Loading: Same as 30-6

N.B. Boron sections of APPR rods changed to configuration of Run Exp 9-30 (Book II p. 205)

Rod 1	Box 9
2	21
3	37
4	25
5	23

Crit Cond.

Water Ht. 92.3 Log N 0.22

Rod	out
Blade	In
APPR Rod	out
" C	In

∴ Abs. Sections all have identical worth

Expr. 30-8 Time 3⁰⁰ ~~AM~~ PM Date 2-7 1956

Purpose

Zero Run 3X +1C APPROVED

Personnel: Dustin JnB J.L

START-UP CHECK LIST

Equipment Checked by J L Personnel Check by MB

Instruments and Safety Devices Tested and Ready by J.L.

"Source In" Checked by JL Source No. —

Emergency Equipment in Control Room Checked by Dustin

Red Light On by ~

Start-Up OK'd by JR Time 3⁸⁰ ~~AM~~ PM Date 2-7 1956

Loading: Same as 30-3 less full plates in slot 17

Boxes 1, 2, 3, 9, 5, 6, 8, 10, 12, 14, 15, 16, 17, 18, 20, 22, 24, 26,

28, 29, 30, 31, 32, 34, 36, 38, 40, 41, 43, 45

$12\frac{1}{2} \times 41 - 32 = 512.5 - 32 = 480.5$ plates → 14.99 kg U-235

$14.99 \times \frac{45}{41} = 16.40$ kg Equiv. U-235

CRITICAL COND:

Sub Critical Neg Pr less than 30 sec

Expr. 30-9 Time 3:25 PM Date 2-7 1956
Purpose
Zero Run 3x+1C APPR Rd
Personnel: DWM MB JL

START-UP CHECK LIST
Equipment Checked by DWM Personnel Check by DWM
Instrument and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by DWM
Red Light On by ✓
Start-Up OK'd by MB Time 3:25 PM Date 2-7 1956

loading: 30-3 less the following plates from SL-17
1, 3, 4, 5, 6, 8, 10, 12, 14, 15, 16, 18, 20, 22, 24, 26
28, 30, 31, 32, 34, 36, 38, 40, 41, 42, 43, 45

MB $12\frac{1}{2} \times 41 - 28 = 484.5$ plates → 15.868 kg U-235

MB $\frac{45}{41} \times 15.868 = 16.54$ kg U-235 Equiv.

blade correction = −0.03

CRIT COND 16.51 kg U-235

Water Height 109.8 R-1 4.2×100×1000
" Temp 64°F LogN 0.15
Control Rod 29.02 DC-3 74×10×10
Blade 10.46 (10' level)
APPR Eccentric 23.99
" Central 0.05

Expr. 29-10 Time 9:30 AM PM Date 2-8 1956
Purpose Check on 20-9
Personnel:

INSTRUMENT CHECK

Date 2-8 1956 Time 9:30 AM PM Source No.

Instrument	Scale	Source Distance	Start-Up Scale
DC-3	65	10×2.0	
Log N	125m		
R-1	4.5	.8×1000 ×100	1'
R-2			
P. M.		800V	1"

Log N calibration — 0.065 meter
0.067 recorder

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by MB
Instrument and Safeties Checked and Reset by JL + MB
Source In Checked by JL Source No.
Emergency Equipment in Control Room Checked by MB
Red Lights On by MB
Start-Up OK'd by JL Time 9:50 AM PM Date 2-8 1956

Loading - same as 30-9.
Critical conditions - 10:32 am: ten minutes after water up.

DC-3	73 (10×10)	Control Blade	12.98
Log N	0.16	" Rod	29.02
R-1	4.4 (100×1000)	APRR Ecc.	24.05
Temp.	64.5°F	" Central	0.02
		Water	109.8

Expr. 30-11 Time 10:55 (AM) PM Date 2-8 1956

Purpose To determine effect of changing half plate from slot 7 to slot 2.

Personnel:

START-UP CHECK LIST

Equipment Checked by DM+MB Personnel Briefed by MB

Instrument and Safeties Tested and Reset DM

"Source In" Checked by DM Notice No.

Emergency Equipment in Control Room Checked by JL

Red Light On by JL

Start-Up OK'd by DM Time 10:55 (AM) PM Date 2-8 1956

Loading - same as 30-10 except the half plate in slot 7 and the full plate in slot 2 interchanged in the following boxes:
2, 4, 15, 17, 29, 31, 42, 44.

Critical conditions

DC-3	79 (10 x 10)	Blade	16.96 ~~17.09~~
R-1	4.4 (100 x 1000)	Rod	29.02
Log N	0.17	APPR - Exc	24.05
Temp	624.5°F	- Control	0.62
		Water	109.8

Blade pulled to 28.30 (out) + positive period measured.

21 sec → 5.3 ¢

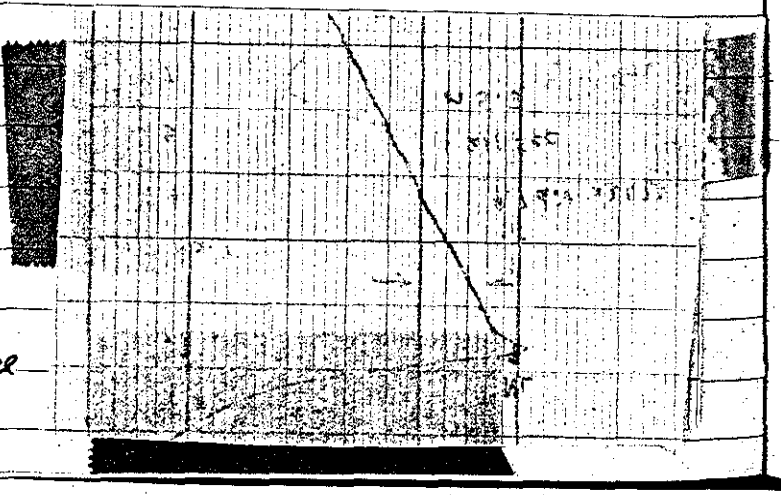
Calib curve → 26. / 21.5 / 3.5 ¢

16.96 21.5

12.96 → .15

6.5 ¢ x 5.3/3.5 = 9.8 ¢

∴ Δk = 9.8 ¢ for the 85-11 and 8 half plate interchange



Expr. 30-11 Time 10:55 (AM) PM Date 2-8 1956

Purpose to determine effect of changing Half plate from slot 7 to slot 2

Personnel:

START-UP CHECK LIST

Equipment Checked by DM+MB Personnel Check by MB

Instrument and Safeties Checked and Tested DM

"Source In" Checked by DM Source No.

Emergency Equipment in Control Room Checked by JL

Red Light On by JL

Start-Up OK'd by DM Time 10:55 (PM) Date 2-8 1956

Loading - same as 30-10 except the Half plate in slot 7 and the full plate in slot 2 interchanged in the following boxes:
2, 4, 15, 17, 29, 31, 42, 44.

Critical conditions

DC-3	79 (10 x 10)
R-1	4.4 (100 x 1000)
Log N	0.17
Temp.	64.5°F

Blade pulled to 28.30 (c

21 1 sec → 5.3 ¢

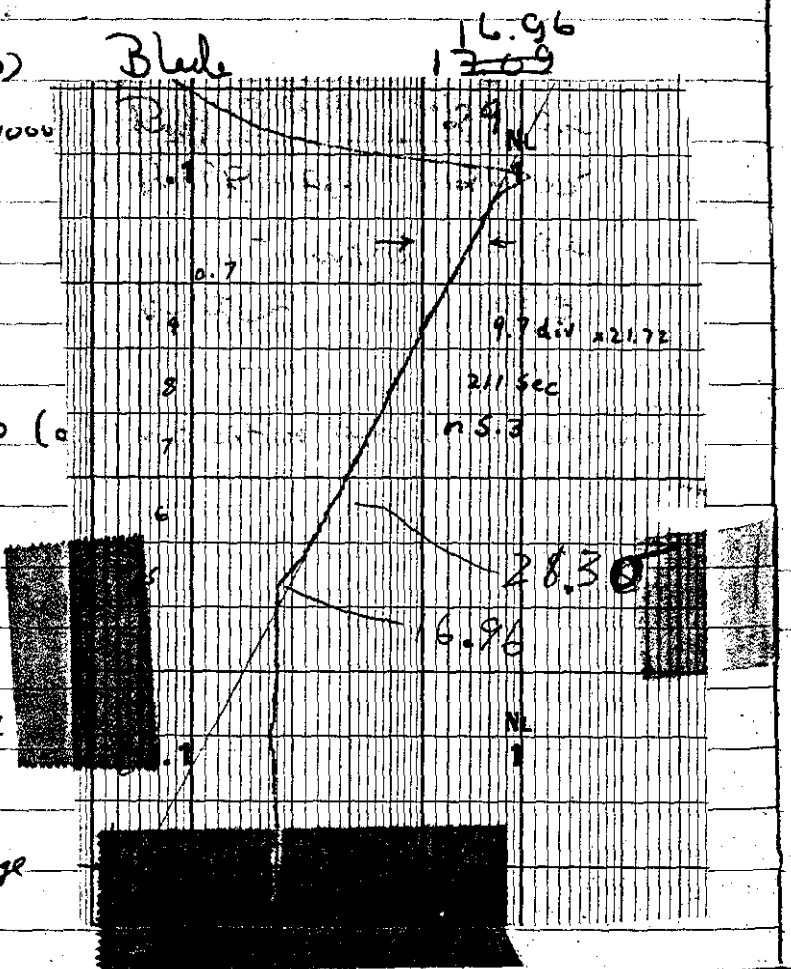
Calib curve → 26. / 21.5 / 3.5 ¢

16.96 21.5

12.96 → 15

6.5 ¢ x 5.3/3.5 = 9.8 ¢

∴ Δk = 9.8 ¢ for the 85 rod and 8 half plate interchange



Expr. 30-12 Time 1 15 PM Date 2-8 1956
Purpose
2 era Rm Half plates in Slot 2
1c + 3 x [redacted] PR Rods
Personnel:

START-UP CHECK LIST
Equipment Checked by Dudm Personnel Check by Dudm
Instruments and Safeties Checked and Reset by MB
"Source In" Checked by MB Source No.
Emergency Equipment in Control Room Checked by Dudm
Red Light On by Dudm
Start Up OK'd by MB Time 1 15 PM Date 2-8 1956

Loading: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18
f f/2 S/S f S/S f f f S/S f f S/S f f S/S f * f

Slot 17

Full fuel plates in Boxes 2, 4, 6, 7, 8, 9, 10, 11, 12, 13, 15, 17, 19
20, 21, 22, 23, 24, 25, 26, 27, 29, 31, 33, 34, 35, 36, 37, 38, 39, 40, 42, 44

SS in 1, 3, 5, 14, 16, 18, 28, 30, 32, 41, 43, 45

$11\frac{1}{2} \times 41 + 29 = 500.5$ → [redacted] 15,566

Duplicates previous Run of Oct -

Crit Cond:

Water Ht	88.8	Log N	0.3
Blade	0.01	DC-3	10 x 10 x 10
Rod	29.02	R-1	3 x 200

Expr. 30-13 Time 1:50 ~~AM~~ PM Date 2-8 1956
Purpose
Zero Run Half Plates Slot 2
Personnel: GMB Dwan

START-UP CHECK LIST
Equipment Checked by Dwan Personnel Cleared by Dwan
Instrument and Safeties Checked and Reset by GMB
"Source In" Checked by GMB
Emergency Equipment in Control Room Checked by Dwan
Red Light On by ✓
Start-Up OK'd by GMB Time 1:50 PM Date 2-8 1956

Loading: Same as 30-12 less 12 plates from slot 17

Full plates in Boxes 2, 9, 7, 11, 13, 15, 17, 19, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45

55 in 24 checkerboard.

$11\frac{1}{2} \times 41 + 17 = 488.5$ $\times 31.1 = 15,192$

$15,192 \times \frac{45}{61} = 16,67$ Reg U 235

Critical Conditions:

Water Ht. 109.8 cm H_2O

Water Temp 64.5 °F

C APPR 0.02

X " Rod 24.05

Cont Bleed 10.83

" Rod 29.02

~~Log A~~ R-1 4.25A/100 x 6000

N 0.15

DC-3 7# x 10 x 10

N.B. Boron detins setting on plastic blocks.

Expr. 30-14 Time 3:30 PM Date 2-8 1956
Purpose
Interaction of fuel in pattern of
3 X +1 C Rod
Personnel: JnB DwDn

START-UP CHECK LIST
Equipment Checked by DwDn Personnel Check by DwDn
Instrument [illegible] by JnB
"Source In" [illegible] JnB Test No.
Emergency [illegible] Control Room Check by DwDn
Red Light On [illegible] DwDn
Start-Up OK'd by JnB Time 3:00 PM Date 2-8 1956

Loading Same as 30-13 plus 12½ plates in 3 X +1 C APPR Rod (out of core)

Critical Conditions:

Water Height	109.8 cm H2O	Log N	0.145	
" Temp	64 °F	R-1	4.25	x100 x1000
C APPR Rod	0.01	DC-3	70	x10 x10
X " "	24.05			
Control Rod	29.02			
" Blade	16.35			

N.P. Lost Reactivity.

START-UP CHECK LIST

Equipment Checked by _____ Personnel Check by _____

Instrument and Safeties Checked and Reset by _____

"Source In" Checked by _____

Emergency Equipment in Control Room Checked by _____

Red Light On by _____

Start-Up OK'd by _____ Time _____ AM PM Date _____ 195__

Expr. _____ Time _____ AM PM Date _____ 195__

Purpose _____

Personnel: _____

Expr. 30-15 Time 401 AM PM Date 2-8 1956

Purpose Zero Run Fuel Removed From 3 X + 1 C APPR Rods

Personnel: _____

START-UP CHECK LIST

Equipment Checked by Dwm Personnal Check by Dwm

Instrument and Safeties Checked and Reset by J.L.

"Source In" Checked by J.L. Source No. _____

Emergency Equipment in Control Room Checked by Dwm

Red Light On by ✓

Start-Up OK'd by _____ Time 400 AM PM Date 2-8 195 6

Loading: Same as 30-13 APPR rods connected as in 30-14 Steel and Fuel removed, only from 3 X + 1 C.

Crit. Conditions Very Very slightly Subcritical

Water Height	109.7	Log N	0.07
Temp	6V	DC-3	34 x 10 x 10
C APPR Rod	D .03	R-1	4.3 x 50 x 1000
X " "	24.05		
Control Rod	29.02		
Blade	28.29		

Expr. 51-1 Time 9:30 AM PM Date 2-9 1956

Purpose To determine if temp. can explain the mass differential between original & newest mass values for 3x-1c.

Personnel:

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by DM

Instrument and Safeties Checked and Reset by DW, MB

"Source In" Checked by DW Source No.

Emergency Equipment in Control Room Checked by MB

Red Light On by DM

Start-Up OK'd by DW Time 9:30 AM PM Date 2-9 1956

INSTRUMENT CHECK

Date 195 Time AM PM Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	65	10x20		
Log N		12 ea.		
R-1	4.6	8x1000 x100	Constant	
R-2				
P. M.		800	1"	

Loading-

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
material	f	f/2	S/S	f	S/S	f	f	f	S/S	f	f	S/S	f	f	S/S	f	f	f

APPR rods in positions 9 21, 23, & 25; fully inserted. } Runs from above.

APPR rod in position 37 full out.

Position 37 has half plate in slot 7, full in slot 2.

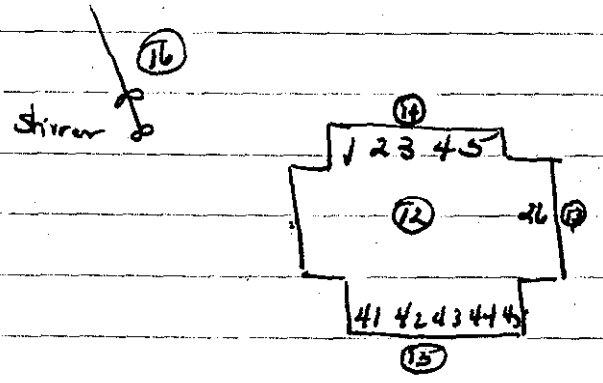
Assemblies in the following boxes instead of fuel in slot 17.

1, 3, 5, 6, 12, 14, 16, 18, 20, 26, 28, 30, 32, 34, 40, 41, 43, 45.

A total of 494.5 plates or 15.379 kg in core.

Air reading of Thermo-couples		Water at 75 cm.
16	64°	65 –
15	64.5°	64 +
14	64.3/4°	64.5
13	64°	65 –
12	63°	64 +

Thermocouple position - all at midplane



∴ heaters ∴

Critical at 94.5 cm. ; blade in, rod out.

109.1 cm. ; blade 0.02; rod

Critical conditions.

Thermocouples #12	#13	#14	#15	#16.	Average			
						#1		
65	65	65	65	65	65	Water 109.1	Log	0.056
						Rod 7.85	DC-3	52 (10x5)
						Blade 0.02	R-1	3.6 (50x1000)
						Time 11:05		
						Rod 9.02: Time 11:10; heater turned on.		
						4:00 11:13 heater turned off.		
						Exchanged a ~~Rod~~ Rod a ~~S~~ plate by a s.s. plate: slot 17, bx 38. 11:22.		
						Left water almost up & went to lunch.		
						#1.a		
65+	65+	65+	65	65+		Water 113.0	Log N	0.09
						Blade 0.02	DC-3	79 (10x5)
						Rod 17.30	R-1	5.7 (50x1000)
						Time 12:08; heater turned on.		
						#2		
66	66.5	66	65	65		Water 113	Log N	
Temp. recorder behaving very unsatisfactory. Putting thermometer into water. — 19°C. (66.2°F)						Blade 0.02	DC-3	81 (10x5)
						Rod 16.9	R-1	
						Time 12:20		
						Blade 0.530	DC-3	81 (10x5)
~~68~~ 69	70	69	~~69~~ 69.5	69		Rod 17.3		
thermometer still reads 19°C						Time 12:33		

Thermometer	Thermocouples #2	13	14	15	16	Ave.	Critical conditions
20°C (68°F)	20°C	20°C	20°C	20°C	20°	20°	Time 12:47 Rod 17.30 We changed to L.+N. galvanometer for the above reading. Blade 2.29 DC-3 74 (10×5)
							Time 12:51; Blade 3.20
20.8	19.2	20.8	19.9	20	20	20.1	Time 1:00; Blade 4.17
	21.1	21.1	21	21	21	21.0	Time 1:17 Blade 5.41
22.15	22.2	22.2	22.2	22.2	21.8	22.2	22.1 Time 1:30 Blade 6.21
							Sudden change in reactivity: 1:35: Blade 5.62.
							1:40; 6.00
	22.7	22.7	22.4	21.9	22.4	22.4	1:45 6.43
							1:54 7.29
23.8	23.8	23.8	23.8	23.8	23.8	23.8	(74.8°F) 2:00 7.71
	24.8	25	25	24.6	24.6	24.8	2:17 8.87
	27.0	27.0	28.0	26.0	26.2		2:30 P Blade 9.60"
26.2	27.8	28.0	28.0	27.2	27.8		2:48 P Blade 10.96
							2:18 12:53.
28.0							3:24 12.92
							Heat cut off — 3:27
	29.2	29.2	29.5	30	29.9		3:30 13.09 ~~13.06~~
28.0							3:39

BLADE & ROD CALIBRATION (from 1209)

Blade pulled to 16.96 and positive period measured.

Time for DC-3 to go from 85 → 70 on 10×20 was 99.2 sec.

Leveled off at 13.09 on the blade, DC-3; 62 (10×50)

Blade inserted to 8.75 and negative period measured

Time for DC-3 to go from 80 → 40 on 10×20 was 133 sec.

Critical Conditions:

Blade 11.61 DC-3 52 (10×10)

Rod (was 17.30) 29.02 Log N 0.1

Blade pulled to 13.09 & another positive period measured

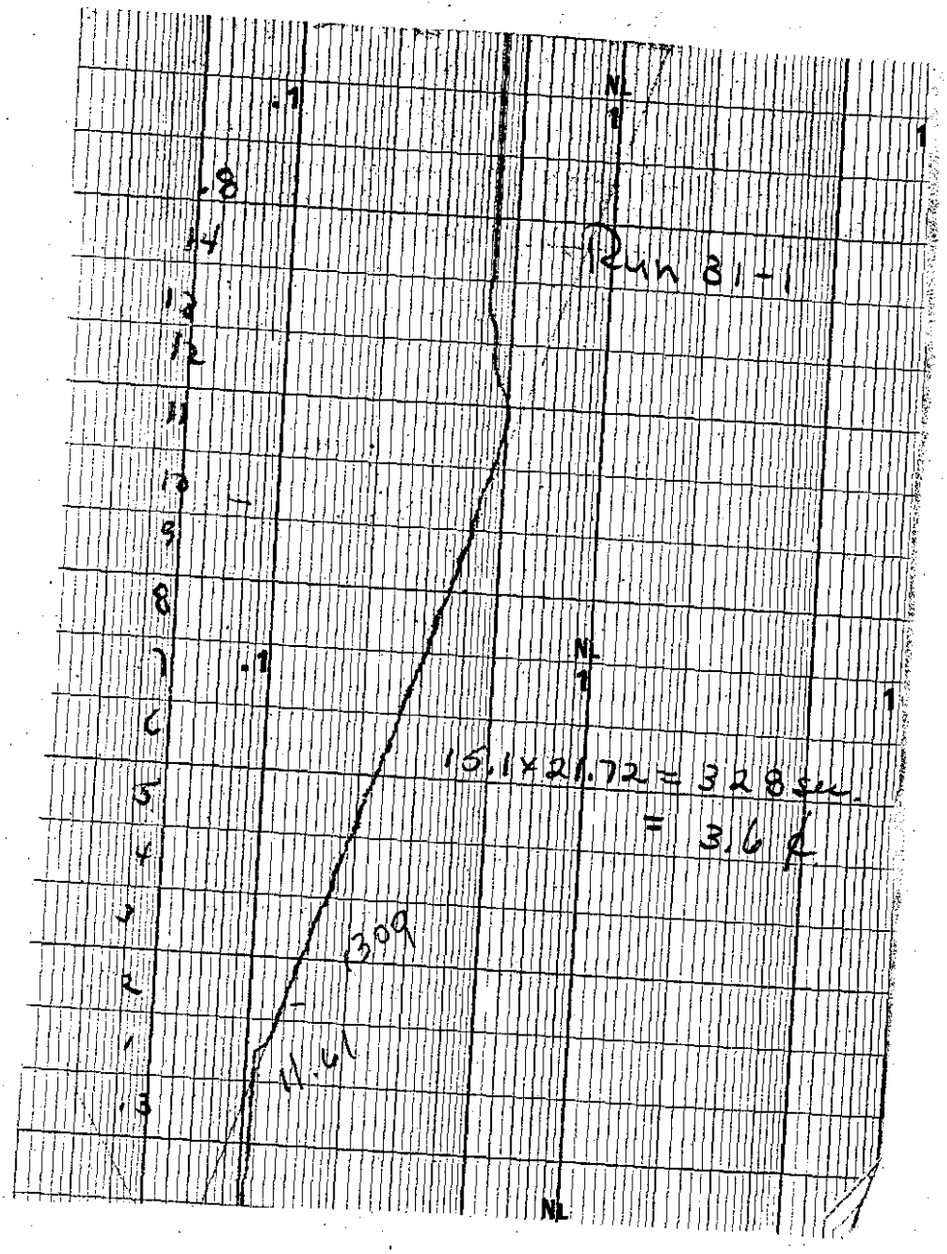
Time for DC-3 to go from 88 → 66 on 10×20 was 244 sec.

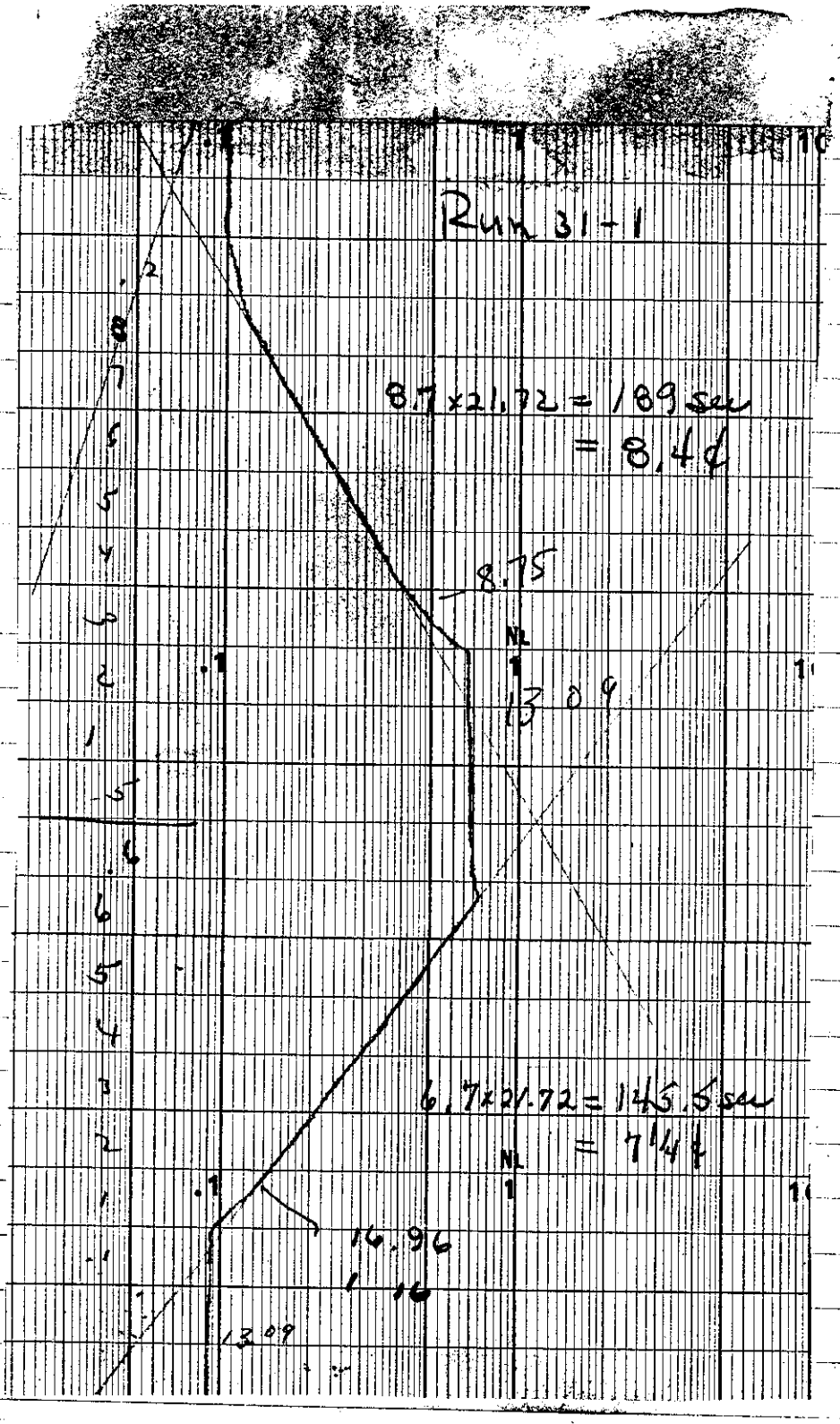
Critical Conditions —

At 4:05, thermocouple #12 reads 29.1°C

Rod inserted ~~[illegible]~~ to 5:00 DC-3 93 (10×20)

Blade 28.30 (out) Log N 0.42


Run 81-1
15.1 x 21.72 = 328 sec.
= 3.6 ft.
1309
11.61
NL
NL
NL


Run 31-1
8.7 x 21.72 = 189 sec
= 8.4 d
8.75
13.09
6.7 x 21.72 = 145.5 sec
= 7 1/4 d
16.96
1.16
13.09

Expr. 22-1 Time 10:00 (M) PM Date 2-10 1956

Purpose Critical mass with rods at 3/4.

Personnel: DM, JL, DW, MB

INSTRUMENT CHECK

Date 2-10 1956 Time 10:00 (M) PM Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	~~>~~	125cm		
Log N	~	10 10x20	7"	
R-1	~ 4.5	.8x1000 x100		
R-2				
P. M.	~	800V	2"	

Log N calibration 0.061 meter
0.065 recorder.

START-UP CHECK LIST

Equipment Checked by MB+JL Pre-connect Check by DM

Instrument and Safeties Checked and Reset by DM

"Source In" Checked by DM Source Out Checked by

Emergency Equipment in Control Room Checked by MB

Red Light On by DM

Start-Up OK'd by DM Time 1005 (M) PM Date 2-10 1956

Loading - complete loading at 12½.

Slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
material	f	½	s	f	s	f	f	f	s	f	f	s	f	f	s	f	f	f

APPR rods 9, 21 & 25 fixed at 4".

APPR rods 23 & 37 attached to motors.

all rods are loaded as above.

Reactor Sub-critical.

Blade	28.29	APPR - Ex	7.81
Rod	29.02	- Cen.	8.01
Log N	0.013	Source In	
DC-3	65 (1x20)	R-1	116 x 50 x 1000)

Expr. 32-2 Time 10:50 AM Date 2-10 1956
Purpose Critical Mass with 314 rods

Personnel: DM, DW, MB.

START-UP CHECK LIST
Equipment Checked by DM+MB Personnel Check by DW
Instrument and Safeties Checked and R... DM
"Source In" Checked by DM
Emergency Equipment in Control Room ... MB
Red Light On by MB
Start-Up OK'd by DM Time 10:50 AM Date 2-10 1956

Loading - same as 32-1 except rods in 9, 21, & 25 are now at 5" instead of 4"

Water tanks dirty & plugging up. Can't get water all the way up.

Reactor Sub-critical:

Rod	29.02	DC-3	90 (1×50)
Blade	28.30	LogN - LogN has been ~~moved~~ lowered approx 2 feet -	0.007
APR - ex	7.81	R_{-1} ~~Temp.~~	4.1 (50×1000)
- cen.	8.01	Temp.	22.2 °C - thermocouple #5.

Expr. 32-3 Time 12:45 PM Date 2-10 1956
Purpose Critical Mass with 5 APPR
Rod ~ 3/4 Inserted
Personnel: DM, DVPW

START-UP CHECK LIST
Equipment Checked by DW+DM Personnel Check by DM
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by DW
Red Light On by DM
Start Up O.K'd by DM Time 12:45 PM Date 2-10 1956

Fixed APPR Rods in 9, 21, & 25 at 6"

APPR rods - ex	7.23	DC-3	62 (10x10)
- cent.	7.23	R-1	2.4 (100 x 1000)
Control Blade	7.77	LogN	0.0095
Rod	29.03	Temp. (on 15)	22.7°C
Water	109.4		

Expr. 32-4 Time 1:35 AM Date 2-10 1956
Purpose Critical mass with 5 APPR rods in 3/4
Personnel: DM, DW, JL, MB

START-UP CHECK LIST
Equipment Checked by DM&JL Personnel Check by MB
Instrument and Safeties Checked and Working DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by DM Time 1:35 AM Date 2-10 1956

Loading - same as 32-1 except APPR rods in 9, 21 & 23 at 6½".
Mass = 17.50 kg U-25

① APPR - C 6.55 Log N 0.023
APPR - X 6.55 P - 1 5.8 (100x1000)
Blade 15.61 DC-3 80 (20x10)
Rod 29.03 Temp (on 15) 22.7 °C
Water 109.8

Mass = 17.49 kg U-25
② APPR - C 6.495 Blade corr -.01
APPR - X 6.55 17.48
Blade 21.23 to 28.0
Rod 29.03

C-APPR rod moved to 6.27 & negative period measured.
Time for DC-3 to go from 72 to 36 on 10x10 was 111.8 sec.

Expr._____ Time_____ AM / PM Date_____ 195__

Purpose_____

Personnel: _____

START-UP CHECK LIST

Equipment Checked by _____ Personnel Check by _____

Instrument and Safeties Checked and Reset by _____

"Source In" Checked by _____ Source No. _____

Emergency Equipment in Control Room Checked by _____

Red Light On by _____

Start-Up OK'd by _____ Time_____ AM / PM Date_____ 195__

Expr. 33-1 Time 4:30 AM Date 2-13 1956
Purpose Critical mass with one boron & rods half way in.

Personnel: DM, JL, MB.

INSTRUMENT CHECK

Date 2-13 1956 Time 4:30 AM Source No.

Instrument	Trip Value	Scale	Source Distance		
DC-1					
DC-2					
DC-3 ✓	60	10×20			
Log N ✓		12sec			
R-1 ✓	35	3×1000			
R-2		×100			
P. M. ✓		800✓			

START-UP CHECK LIST

Equipment Checked by DM Personnel Check by DM
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by DM Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by DM
Start-Up OK'd by DM Time 4:30 AM Date 2-13 1956

Loading -

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
material	f	f	s/s	f	s/s	f	B	f	s/s	f	f	s/s	f	f	s/s	f	s/s	f

APPR rods in half way in normal position

While pulling blade, magnet circuit opened & rods & safety dropped.

Reactor was quite obviously not going critical. Blade was pulled to 8 inches with full water height & power had not increased by a factor of 2 yet.

Note: S.S. were missing from slot 17 boxes 34 & 35

Expr. 33-2 Time 5:30 A.M. P.M. Date 2-13 1956

Purpose: Critical Mass with one boron + rods Half in.

Personnel: DM, JL, MB

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by JL

Instrument and Safety Channels Checked and Reset by MB

"Source In" Checked by DM Source No.

Emergency Equipment in Control Room Checked by MB

Red Light On by MB

Start-Up OK'd by DM Time 5:30 A.M. Date 2-13 1956

Loading –

same as 33-1 except full chunker board of 24 full plates added to slot M.

(total of 519 fuel plates in core & on rods.)

All APPR rods are in half way with fuel sections attached.

Critical Conditions –

Blade	0.00	DC-3	91 (10×20)
Rod	5.06	R-1	5.9 (100×1000)
APPR-X	12.01	LogN	0.0225
-cen.	12.00	temp (#15)	18.1°C
Water	109.4		

Water is dumping at 11 cm/min. – this seems slow.

We estimate that the excess k of this loading is ~4½. 3¢ in the blade & 1½¢ in the rod.

Critical mass: (11×45 + 24) 31.1 = 16.14 kg

blade correction = 45¢; @ ⅓ ¢/gm = −.15

15.99 kg.

Expr. 3.4-1 Time 9:25 AM PM Date 2-13 1956
Purpose Critical mass with rods half in for power distribution.
Personnel:

START-UP CHECK LIST
Equipment Checked by MB Personnel Check by DM
Instruments and Safeties Checked and Set DM
Source In Checked by DM Source No
Emergency Equipment in Control Room Checked by JL
Red Light On by JL
Start-Up OK'd by DM Time 9:25 AM PM Date 2-13 1956

Loading-

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
material	f	$\frac{s}{s}$	f	$\frac{s}{s}$	$\frac{s}{s}$	f	$\frac{s}{s}$	f	$\frac{s}{s}$	f	$\frac{s}{s}$	f	$\frac{s}{s}$	f	$\frac{s}{s}$	f	$\frac{s}{s}$	f

APPR rods in positions 9, 21, 25 at 11 7/8"

APPR X 11.78
Cent. 13.93

With water up, reactor sub-critical.
log N .0019
DC-3 79 (1' x 26)
Source in.

Unfortunately, one boron plate was left in each control rod-end section.

Expr. 34.2 Time 10:20 (AM) PM Date 2-13 1956
Purpose Critical mass with rods full in.

Personnel: DM, JL, MB

START-UP CHECK LIST

Equipment Checked by MB Personnel Check by DM
Instruments [illegible] and Reset by JL
"Source In" [illegible] DM Source No.
Emergency [illegible] Control Room Checked by MB
Red Light On by MB AM
Start-Up OK'd by DM Time 10:20 (PM) Date 2-13 1956

18 f

Loading - same as 34-1 except boron pulled from rod boxes (+replaced by S-S.). Rod boxes are now exactly the same as the rest of the core.

Critical Conditions.

(1.) HPPR -x	11.87	DC-3	80 (10×20)
-cent.	12.70	R-1	2.2 (200×1000)
Blade	0.01	LogN	.019
Rod.	~~24.03~~ 15.3	Temp. (#15)	18.2°C
Water	109.6		

(2) HPPR -cent.	12.51	(3.) APPR-cent.	12.29
Blade	5.09	Blade	8.08
Rod.	15.3	Rod.	15.3

	(4)	(5)	(6) slightly Sub	(7.)
(8) APPR-cent.	12.13	12.00	11.89	11.89
Blade	10.44	13.18	28.30	28.30
Rod	15.3	15.3	15.3	19.66

Critical condition (cont.)

8.

APPR- crit.	11.89
Blue	20.98 ~~29.8~~
Red	29.09

Expr. 35-1 Time 5:00 AM PM Date 2-14 1956
Purpose Power Distribution with all rods at half way. 2nd Run.
Personnel: JL DM, MB.

START-UP CHECK LIST

Equipment Checked by JL Personnel Check by DM+MB
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by JL Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by DM
Start Up Authorized by JL 5:30 AM Date 2-14 1956

INSTRUMENT CHECK

Date 2-14 1956 Time 5:00 AM PM Source No. 8

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	40	10x20	5"	
Log N	✓	12 div		
R-1	6.0	.6 x10³	6"	
R-2		x10³		
P. M.	✓	800 V	0"	
				D.W.

Loading – same as 34-2 ~~with~~ but with all rods at 12" instead of 11 7/8".

Critical Conditions

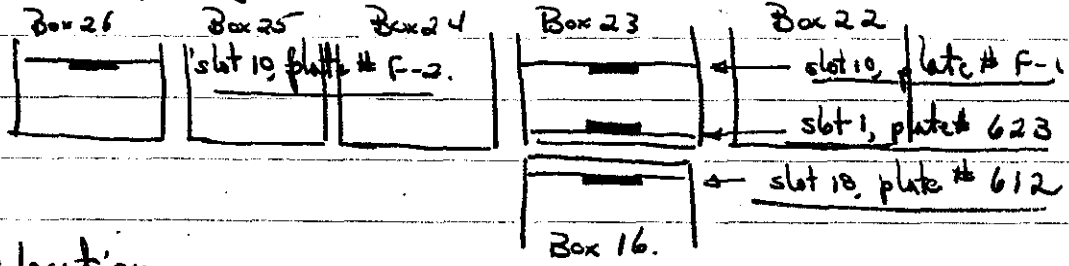
Blade	6.98	DC-3	80 (10×10)
Rod	9.005	R-1	5.6 (50×100)
APPR-Ex	11.995	Log N	.0105
-Cent.	12.015	Temp (#5)	18°C
Water	109.61		

Expr. 35-2 Time 6:30 (AM) Date 2-14 1956
Purpose Power Distribution with Rods full in.; Vertical.
Personnel: JL, MB

START-UP CHECK LIST
Equipment Checked by DM Personnel Check by DM
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by JL Shorting Bar Removed
Emergency Equipment in Control Room Checked by MB
Red Light On by MB
Start-Up OK'd by JL Time 6:30 (PM) Date 2-14 1956

25-1.

Plate Location loading - same as ~~90-2~~.



Foil location.

Distance from top.	Plate # 612	623	F-1	F-2
1	210	219		
3		220		
5	211	221		
7		222		
9	212	223		
11	213	224		
13	214	225		
15	215			
17	216	226	228	229
19	217			
21	218	227		

½ power (0.062) at 6:49:43
Photo-multiplier turned down to 750 V.
Run conditions - (at 15 min)

Blade	7.20	DC-2	4/7 (1×20)
Rod	29.03	R-1	4.95 (1000×1000)
APPR-X	11.99	$\log_e N$	0.17
-cen.	12.00	temp.	18°C
Water.	109.7		

Twenty minute exposure

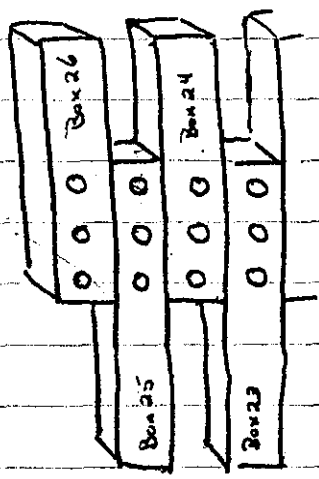
Expr. 35-3 Time 9:00 AM PM Date 2-14 1956
Purpose Power Distribution with Rods half way in; horizontal
Personnel: JL, MB

START-UP CHECK LIST
Equipment Checked by JLWMB Personnel Checked by JL
Instrument and Safeties Checked and [illegible] MB
"Source In" Checked by JL
Emergency Equipment in Control Room Checked by JL
Red Light On by MB
Start-Up OK'd by JL Time 9:00 AM Date 2-14 1956

Loading - same as 35-1.

Foil Location:

All foil plates in slot 10 with foils facing slot 9.



Box	Plate	Foils distance from top of plate		
23	623	at 1" - 233	at 5" - 234	at 9" - 235
24	F-1	13" - 236	17" - 237	21" - 238
25	612	1" - 230	5" - 231	9" - 232
26	F-2	13" - 239	17" - 240	21" - 241

1/e final power (0.062) at 9:39:37

Run conditions –

Blade	7.66	DC-2	45 (1×20)
Rod	29.03	R-1	4.95 (1000×1000)
APPR - cent.	12.00	Log N	0.17
– x	11.99	Temp-	18°C
Water.	109.5		

Twenty minute exposure

Expr. 36-1 Time 6:00 AM (PM) Date 2-15 1956

Purpose APPR Rod calibration.
Part I- central rod vs. eccentric rods.

Personnel:

INSTRUMENT CHECK

Date 2-15 1956 Time 6:00 AM (PM) Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	—	60	10×20	
Log N	—		12cm	
R-1	—	6	.7×10⁶ #10.	
R-2				
P. M.	—		800V	1"

APPR rod position re-calibrated (0.00 = rods flush with fuel element boxes) Because of placing of the Salson's, this can be set up no better than ±0.05

X APPR ROD READS .05 HIGH

C ENTRAL ROD READS .015 LOW

START-UP CHECK LIST

Equipment Checked by D M Personnel Check by D M

Instrument and Safeties Checked and Reset by M.B.

"Source In" Checked by M B Source No. D M

Emergency Equipment in Control Room Checked by D. M

Red Light On by D M

Start-Up OK'd by M B Time 7:30 AM (PM) Date 2-15 1956

LOADING

SLOT	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	t	S	f	S	S	f	S	*	S	t	-	S	t	S	f	-	S	f	S	t
											FUEL						FUEL			

SLOT 8 CONTAINS 24 HALF PLATES & 21 FULL PLATES

NB BORON SECTIONS ATTACHED TO ALL APPR RODS

4 X APPR RODS ALL THE WAY OUT

" CENTRAL ROD FULL IN

REACTOR NOT CRITICAL

$8 \times 45 + 24 \times \frac{1}{2} + 21 = 360$

$+12$

$+21$

393 plates in all 45 elements.

-9 (CO)

384 plates in core.

Expr. 36-2 Time 800 ~~PM~~ Date Feb 15 1956
Purpose
Cal. APPR Rod Calib.
Personnel: MB JL DM

START-UP CHECK LIST
Equipment Checked by DWM Personnel Check by DWM
Instrument and Safeties Checked and Reset by JL
"Source In" Checked by MB Source No. —
Emergency Equipment in Control Room Checked by DWM
Red Light On by ✓
Start-Up OK'd by MB Time 800 ~~PM~~ Date Feb 15 1956

Loading: Added 12 ½ plates (interchange full ~~light~~)

	8 x 44	=	352
Slot 8	12 x ½	=	6
	32	=	32

✓ MB

390 plates in core → 12.129 kg U-235
Non Load. $X^{15}_{U_5}$ = 12.40 kg U-235

Slot 8 half plates in Boxes 6, 8, 10, 12, 20, 22, 24, 26, 34, 36, 38, 40.

Boron Section Cent. APPR Rod IN CORE.

CRIT. COND:

Water Ht.	95.0	Log N	.011
" Temp	19.3 °C	DC-3	42 x 10 x 20
Control Rod	0.11	R-1	3.3 x 100 x 1000
" Blade	0.00		
Ec APPR	24.05		
Cent "	.045		

Expr. 36-3 Time 8^25 AM PM Date 2-15 1956

Purpose

CENT APPR ROD CALIB

Personnel: MB JL DM

START-UP CHECK LIST

Equipment Checked by DWM Personnel Check by DWM

Instrument and Source Checked and Reset by JL

"Source In" Checked by MB Source No.

Emergency Magnets in Control Room Checked by DWM

Red Light On by ✓

Start-Up OK'd by MB Time 8^25 AM PM Date 2-15 1956

LOADING: REMOVED 4 ½ plates (Interchange full & half)

Slot 8 has half plates in Boxes 3, 6, 8, 10, 12, 16, 20, 23, 24, 26

30, 34, 36, 38, 40, 43.

8 x 44 = 352

16 x ½ 8

28 28

388

✓ MB

Nom Load 45/40 x → 12.35

plates in core → 12.067 kg U-235

BORON SECTION CENT APPR ROD IN CORE

CRIT. COND.

Water Ht	109.5	Log N	0.017
" Temp.		DC3	69.5 x 10 x 20
Control Rod	29.03	R-1	4.18 x 100 x 100 a
" Blade	9.81		
Ecc. APPR	24.05		
CENT "	0.095		

✓ MB.

12.067 16 ℓ excess

✓ 12.04 kg core ℓ

$12.04 \times \frac{45}{40} = 12.31$

$\begin{array}{r} 12.31 \\ -10.59 \\ \hline 1.72 \end{array}$

192

Expr. 36-4 Time 8⁵⁰ ~~AM~~ PM Date 2-15 1956

Purpose

CENTRAL VS. ECC APPR RODS.

Personnel:

START-UP CHECK LIST

Equipment Checked by DWM Personnel Check by DWM

Instrument and Safeties Checked and Tested by JL

"Source In" Checked by MB Counts No. —

Emergency Equipment in Control Room Checked by DWM

Red Light On by —

Start-Up OK'd by MB Time 8⁵⁰ ~~AM~~ PM Date 2-15 1956

LOADING: SAME AS 36-3

BORON APPR ROD 16 9/16 IN CORE

" " " 23 Out of CORE

Screw Troubles — pushed it away from opening DWM JL

CRIT. COND.

Water Ht 109.7

Water Temp

Cont Rod 29.03

" Blade 9.81

Central APPR ~~23.995~~ 24.05

EC 37 APPR 7.26

Box 9 APPR

Log N .029

DC3 45.5X10X50

R-1 3.3₃ X100X200

DC-1 26.3 X

Expr. 36-5 Time 11:30 AM (PM) Date 2-15 1956
Purpose Rod ~~Evaluation~~ & Calibration
9 vs. 37. — zero run:
Personnel: DW, DM, JL, MB

START-UP CHECK LIST
Equipment Checked by JL Personnel Check by MB
Instrument and Safeties Checked and Reset by DM
"Source In" Checked by DW Source No.
Emergency Equipment in Control Room Checked by MB
Red Light On by DM
Start-Up OK'd by DW Time 11:30 AM (PM) Date 2-15 1956

Loading — all boxes & APPR rods in positions 9 & 37.

slot	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
material	f	S_s	f	S_s	S_s	f	S_s	S_s	f	S_s	S_s	f	S_s	f	S_s	f		

except boxes 8, 10, 36 & 38 contain full fuel in slot 10 instead of S.S.

"central" rod drive moves APPR rod in position 9.

Critical Conditions —

DC-3	4/8 (10×20)	Blade	4.81
R-1	3.6 (100×1000)	Rod	29.03
DC-1	53.6 (50)	APPR-excentric; 37	24.00
LogN	0.0128	-"central"; 9	0.00
Temp.	19.3°C (15)	Water	109.5

9
10×50
100×200

APPR-9 pulled to 3.88 for trial period measurement.; period meters show approx. 90 sec.
Leveled off with APPR-37 at approx. ~~21.35~~ 21.28 with LogN at 0.28 (photomultiplier set at 800V)
Inserted APPR-37 to 19.99 & negative period taken. period meters show approx. — 150 sec.

Leveled off with APPR-9 by pulling ~~it~~ to approx. 6.5°

APPR-9 pulled to 6.45. Period meter reading ~ 90sec.
Photo-multiplier was set at ~~2000~~ 736 volts. Scram'd
us at $\text{Log}\, N = 1.1$

Expt. 36-6 Time 4:30 AM (PM) Date 2-16 1956

Purpose Rod calibration - 9 vs. 32

Personnel: DW DM, JL, MB.

INSTRUMENT CHECK

Date 2-16 1956 Time 4:30 AM (PM) Source No.

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	✓	62	10×20	5"
Log N	✓		12cm	
R-1	✓	5	7400 ×100	
R-2				
P. M.	✓		700V	1/2"

DC-2 trips at 75 - (10×20)

Loading - same as 36-5

START-UP CHECK LIST

Equipment Checked by DM Personnel Check by DM

Instrument and Safeties Checked and Reset by MB

"Source In" Checked by DW Source No.

Emergency Equipment in Control Room Checked by DW

Red Light On by DM

Start-Up OK'd by DW Time 4:40 AM (PM) Date 2-16 1956

Initial Critical Position.

DC-3; moved out of thimble	58 (1×20)	Blade	5.77
DC-1	—	Rod	29.03
DC-2	76 (1×20)	APPR - box 37	24.08
R-1	5.6 (500×1000)	- box 9	0.00
Log N	0.095	Water	109.3
Temp.	193 (#15)		

Case	#9	#37	Disposition of reactor	Est. period	Est. Value	Est. Sensitivity	Actual period
1.	0.00	24.08	Level; Log N=0.095	∞			∞
2.	3.49	24.08	positive period	150 sec.	7 ¢.	2 ¢/in	
3.	3.49	~~24.00~~ 21.40	negative period	~~200~~ -400	3.5 ¢.	~~2 ¢/in~~ 3.9 ¢/in.	
4.	5.15	~~24.00~~ 21.40	~~positive period~~	200	5.3 ¢.	5.3	
5.	5.15	19.54	negative	~~200~~ -200	8.2	6.9	
6.	6.74	19.54	positive.	110	9	10.0	
7.	6.74	18.27	negative. ~~clock~~	~~200~~ 164	~~6.2~~ 10.6	~~10 ¢/in~~ 15.4	
8.	8.10	18.27	positive. ~~clock~~	78	11.7	16.4	
9.	8.10	16.99.	negtive.	143	13.1	19.4	
10.	9.24	16.99	positive.	83	11.2	21.3	
11.	9.24	16.02	negtive.	~~148~~ 168	~~17.4~~ 10.3	22.2	
12.	10.15	16.02	positive	83	11.2	23.6	

Case	#9	#37	Disposition	Est. period	Est. value	Est. Sensitivity	Actual period.
13	10.15	15.09	negative.	160	11	~~22.9~~ 29.9	
14.	11.03	15.09	positive	81	11.4	26.8	
15	11.03	14.20	negative.	151	12.1	26.4	
16.	11.93	14.20	positive	76	12	26.8	
17	11.93	13.36	negative	179	9.8	26.0	
18	12.75	13.36	positive	74	13.1	26.4	
19	12.75	12.59	negative	168	10.4	29.2	
20.	13.55	12.59	positive	85	~~9.8~~	~~25.4~~	
21	13.55	11.88	negative	262	5.8	22.1	
22.	14.31	11.88	positive	70	12.7	24.4	
23	14.31	11.11	negative.	182	9.2	25.8	
24	15.16	11.11	positive	81	11.4	24.2	

Case	#9	#37	Disposition	Est. Period	Est. Value	Est. Sensitivity
25	15.16	10.30	negative	175	9.7	26.1
26	~~15.16~~ ~~15.15~~ 16.15	10.30	positive.	65	13.5	23.4
27.	16.15 ~~15.16~~	9.40	negative.	199	8.2	24.1
28	17.22	9.40	positive	73	12.3	19.2
29	17.22	8.09	negative	126	16.4	21.9
30	18.83	8.09	positive	63	13.9	18.8
31	18.83	6.74	negative	178	9.4	17.3
32	20.33	6.74	positive	102	9.4	12.5
33.	20.33	5.14	negative.	186	8.9	11.4
34.	23.96	5.14	positive	87	10.8	6.4
35	23.97	3.75	level	∞	0	7.8
36	23.97	0.10	negtive	182	9.2	

Expr. 36-7 Time 11:30 (AM) PM Date 2-16 1956
Purpose Rethink some points on 36-6
Personnel: DW. DM, JL MB

START-UP CHECK LIST
Equipment Checked by DM Personnel Checked by MB
Instrument and Safeties Checked and Reset by DW
"Source In" Checked by DW
Emergency Equipment in Control Room Checked by JL
Red Light On by MB
Start-Up OK'd by DW Time 11:30 (AM) PM Date 2-16 1956

Loading - same 36-6.

Chute case 19	# 9	#37	Disposition	Approx. Rated
1-A	12.45	13.345	Approx Level	(Blade 6.00)
2-A	12.25	13.35	Positive	110 sec. 8.9 ft.
(19) 3-A.	12.75	12.60	Negative	166 sec. 10.4 ft. 25.7
(20) 4-A	13.54	12.60	Positive	100 sec 9.6 ft. 25.3
(21) 5-A	13.54	11.86	Negative.	178 sec. 9.4 25.7

200

INSTRUMENT CHECK

Date 2-17 1956 Time 4 30 PM Source No. Gamma

Instrument	Trip Value	Scale	Source Distance	Start-Up Scale
DC-1				
DC-2				
DC-3	50	10x20	contact	
Log N				
R-1	7	100x100	contact	
R-2				
P. M. 900 V			4"	
Period	OK	15sec		

Expr. 37-1 Time 4 45 PM Date 195

Purpose

Comparison of Round and Square Rods

Personnel: DVPW, DWM

START-UP CHECK LIST

Equipment Checked by DWM Personnel Check by DVPW

Instrument and Safetics Checked and Reset by DWM

"Source In" Checked by DVPW Source No. 1

Emergency Equipment in Control Room Checked by DWM

Red Light On by DWM

Start-Up OK'd by DVPW Time 4 45 PM Date 2-17 1956

Loading: Box 23 Contains Round Rod OD 2 3/4"

Complete 8 plate loading + 24 plates in checkerboard.

8 x 44 = 352

24 24

376

Sat Out.

Expr. 37-2 Time ~~5~~ 20 ~~PM~~ AM Date 2-17 1956
Purpose Ditto
Personnel: DVPW DWM

START-UP CHECK LIST
Equipment Checked by DWM Personnel Check by DWM
Instruments and Safety Checked and Set by DWM
Source Inserted by DVPW Source No. ~
Emergency Equipment in Control Room Checked by DWM
Red Light On by ✓
Start-Up OK'd by DVPW Time 5.20 ~~PM~~ AM Date 2-17 1956

Loading: 8 plates per box +32 plates
352 + 32 = 384 plates. +8 checkerboard (2, 4, 15 17 39 31 42 44)
N.B. 2 3/4" Rd Rod in Center Box 23.

CRIT. COND:

Water Ht	109.2	Log N	.02
Blade	10.16	DC-3	90 X 20 X 10
Cont Rod	29.03	R-1	5.3 X 100 X 1000
APRR Rod 9	24.00		
37	24.00		

WATER TEMP = 20.2°C

384 x 31.1 = 11.94 kg U-235 15.54 excess k
30 g
15.5
.53
corrected 11.91 kg

APPR 12.04

202

Expr. 37-3 Time 5 50 AM PM Date 2-17 1956

Purpose

O. vs □.

Personnel: DVPW JL DWM

START-UP CHECK LIST

Equipment Checked by DWM Personnel Checked by DWM

Instrument and Safeties Checked and Reset by DWM

Source In" Checked by DVPW Source No.

Emergency Equipment in Control Room Checked by DWM

Red Light On by ✓

Start-Up OK'd by DVPW Time 5 58 AM PM Date 2-17 1956

Loading: Same as 37-2

: Exchanged ~~Rod~~ Round and Square Rod (□ rod in 23 row).

CRIT. COND.

Water HT	109.3	Log N	.02
APPR Rod 9	24.00	DC-3	40 x 50 x 10
37	18.29	R-1	5.8 x 100 x 1000
Blade	10.18		
Rod	29.03		

$\therefore \Delta k(\bigcirc - \square) = \cdot \text{Rod } 37 (24.00 - 18.29)$

	9	37	Blade (10.18)	Rod	Period (time	
①	24.00	18.29	14.40	29.03	76.7 sec	11.8¢
~~②~~	~~24.00~~	~~17.52~~			~~Level~~	
②	24.00	17.52	"	19.57	Level	
③	"	"	10.18	"	Neg 159 sec	11.2¢

From Preliminary calibration of APPR rod 37, $24.08 - 18.27^{0} = 43.6¢$

$\therefore$ ○ − □ = Δk of ~ 44¢

Final value for 37 calibration.

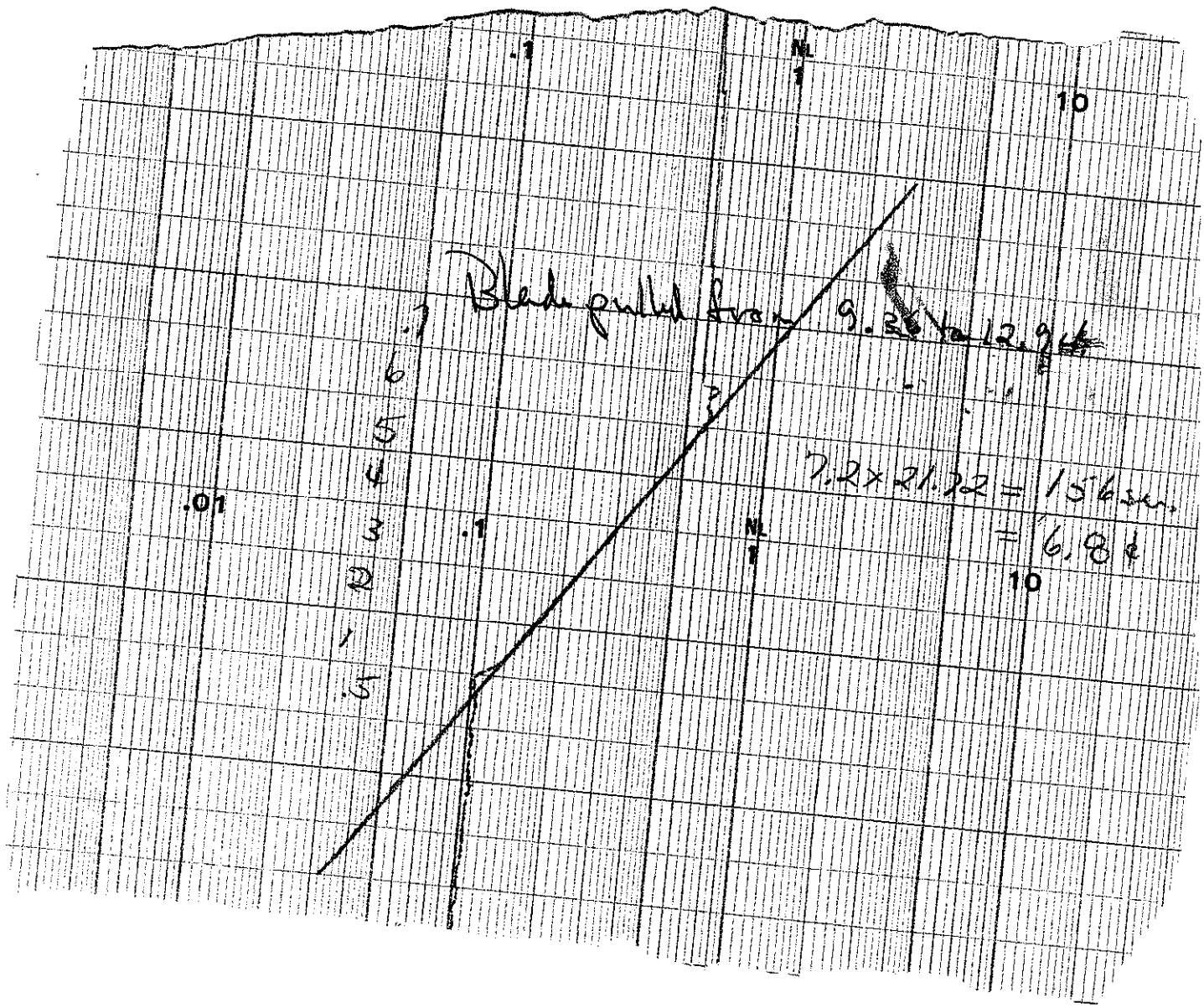
$24.08 - 18.27 = 54¢$

0

1000

APPR − ○ Rod = 12.04 − 11.91 = 0.13 kg $\times^{48}$ ~ 62¢

○ Rod − □ Rod = 54¢ or $\frac{105}{11.9} \times .54$ ¢/g = 0.48 ¢/g ~ 110 g


.1
NL
1
10
.01
.1
NL
1
10
6
5
4
3
2
1
.5
Blade pulled from 9.26 to 12.96
7.2 x 21.22 = 153 sq. in.
= 6.8 ft

SECRET

Classification Changed to Decl.
Authority of J.H. Kahn Date 6/3/60

SECRET